Summary of Yesterday – Proposed Revisions

Order 3

- Facility Measurement Points
- Commingling
- Site facility diagrams
- Documentation of all access to tanks

Order 4

- Overall uncertainty (performance) goals
- Acceptance of Coriolis Measurement Systems
- Adoption of new industry standards

Summary of Yesterday – Proposed Revisions

Order 5

- New industry standards
- Charts ≤ 100 Mcf/day
- 4 tiers of performance goals
- Meter tube inspections
- Dynamic sampling frequency (> 100 Mcf/day)
- Gas sampling, analysis, and reporting requirements
- Type testing and approval by make, model, and size for transducers, flow computer software, isolating flow conditioners, and differential primary devices

Summary of Yesterday – Proposed Revisions

Common to all orders:

- Enforcement provisions moved to handbook
- 7-year record retention for Federal records
- Record retention requirements apply to transporters/ purchasers
- Immediate assessments for selected violations

Topics requested to be covered in more detail

- Proposed changes to site facility diagrams (3)
- Gas variability study
- Basis of the proposed 4 tiers (5)
- Basis of proposed 0.25 mol% trigger for C9+ analysis (5)
- Can regulations automatically incorporate the latest version of an industry standard by reference?

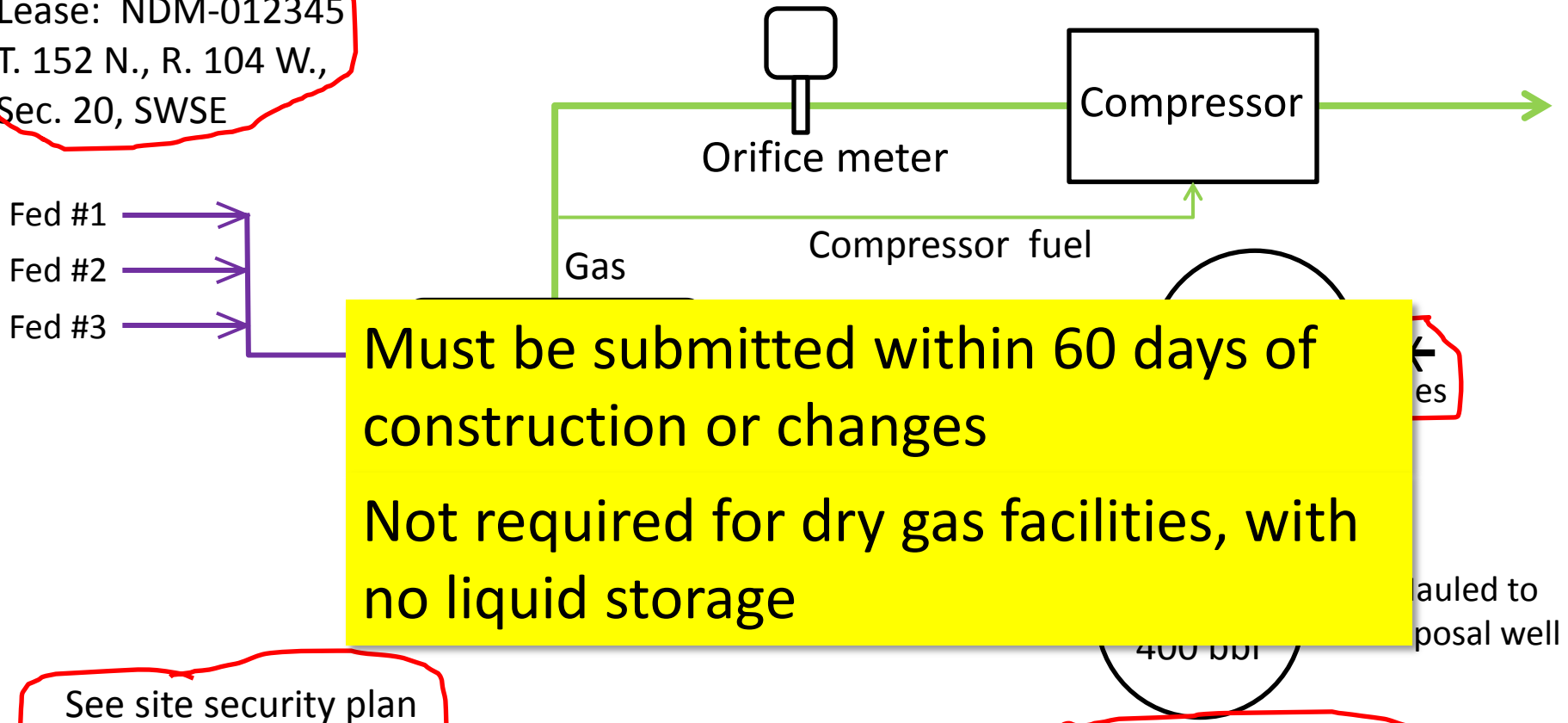
Topics requested to be covered in more detail

- Proposed changes to site facility diagrams (3)
- Gas variability study
- Basis of the proposed 4 tiers (5)
- Basis of proposed 0.25 mol% trigger for C9+ analysis (5)
- Can regulations automatically incorporate the latest version of an industry standard by reference?
- *Proposed economic test for "low-volume" FMPs (3)*
- *Coriolis proposed revisions (4)*
- *Off-lease measurement (3)*

Site Facility Diagram

Site Facility Diagram – existing requirements

Lease: NDM-012345
T. 152 N., R. 104 W.,
Sec. 20, SWSE



Must be submitted within 60 days of construction or changes

Not required for dry gas facilities, with no liquid storage

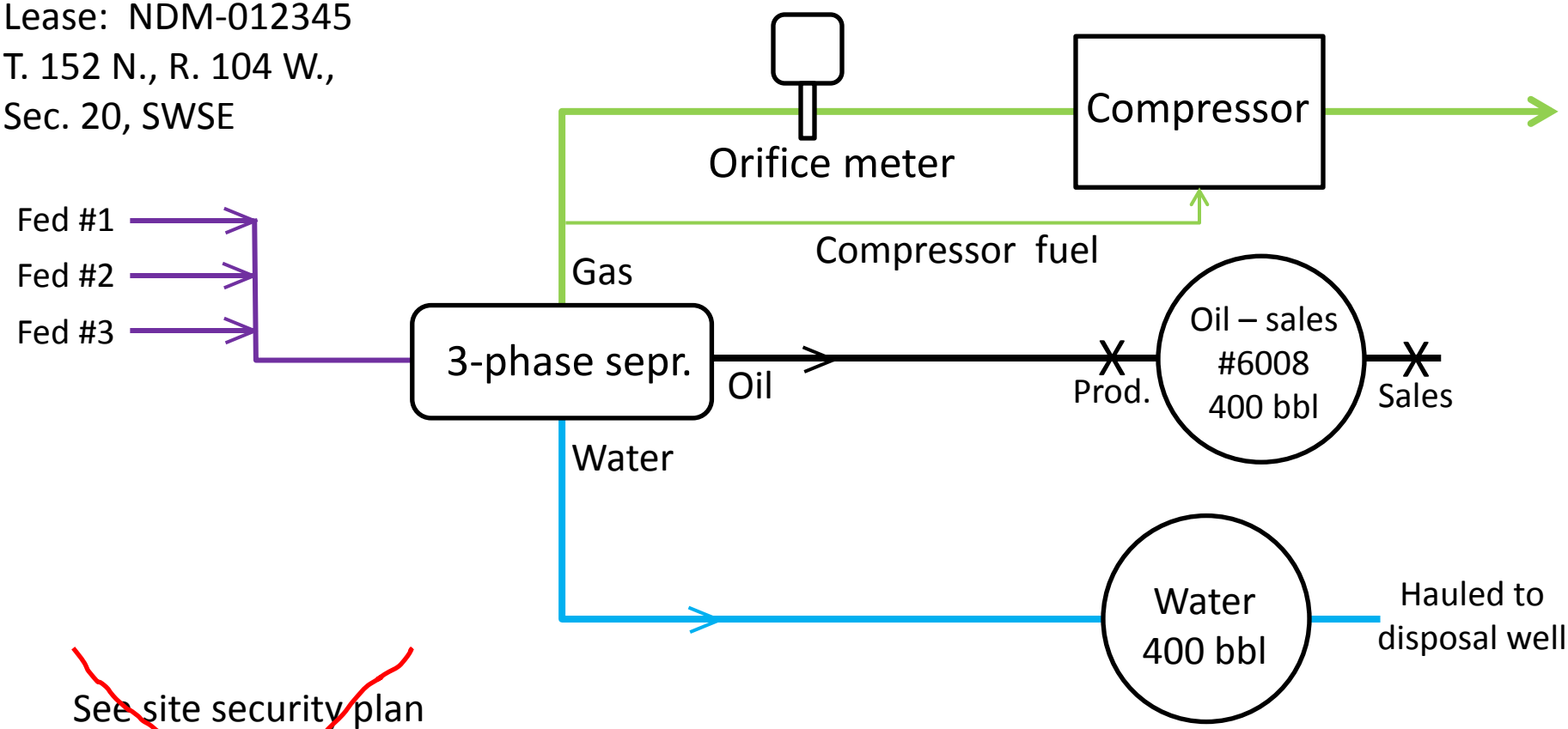
See site security plan #012345, 6/16/2009, located at:
2550 N. State St.
Ukiah, CA 95482

Phase	Prod. Valve	Sales Valve
Production	Open	Closed*
Sales	Closed*	Open

*effectively sealed

Site Facility Diagram – proposed revisions

Lease: NDM-012345
T. 152 N., R. 104 W.,
Sec. 20, SWSE



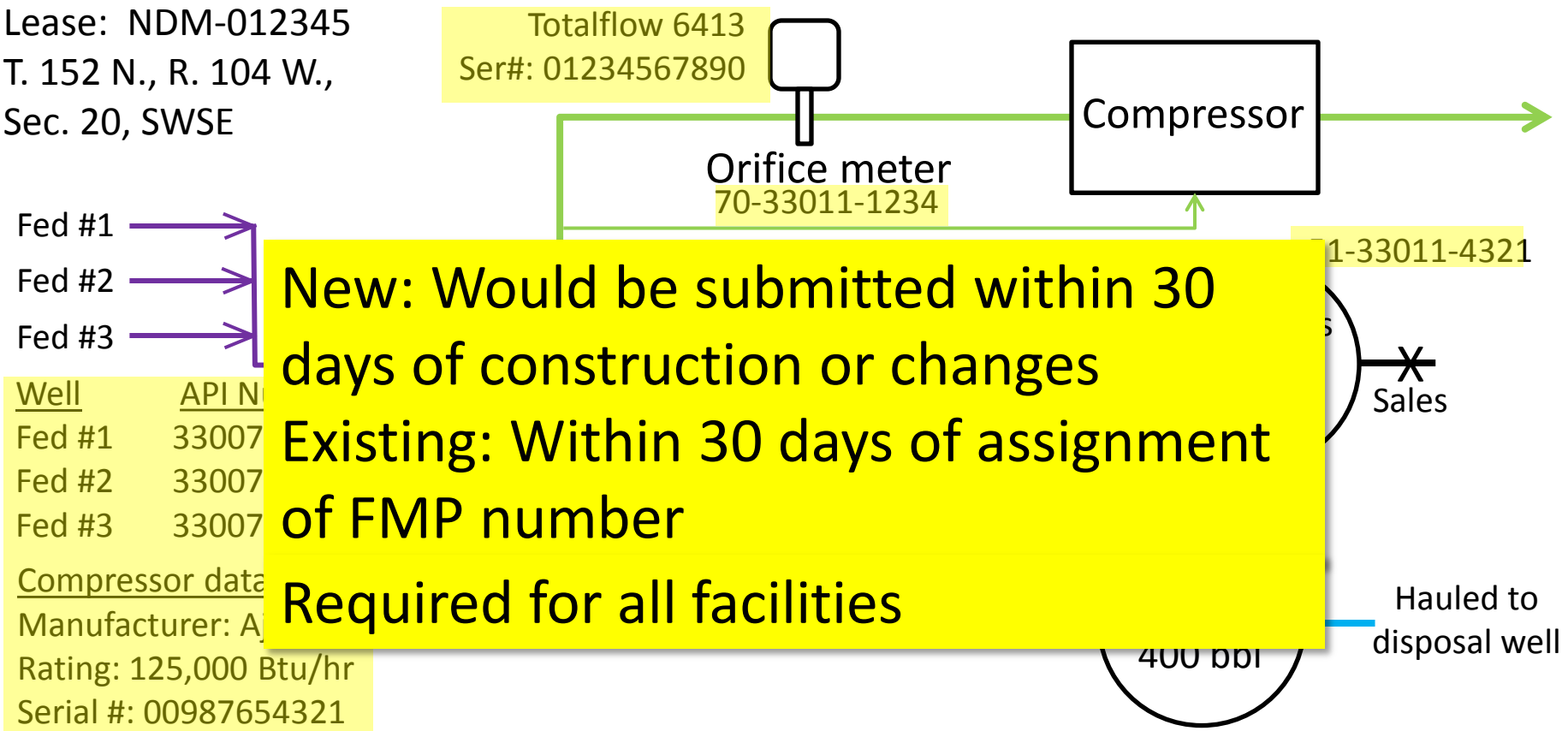
~~See site security plan #012345, 6/16/2009, located at:~~
~~2550 N. State St.~~
~~Ukiah, CA 95482~~

Phase	Prod. Valve	Sales Valve
Production	Open	Closed*
Sales	Closed*	Open

*effectively sealed

Site Facility Diagram – proposed revisions

Lease: NDM-012345
T. 152 N., R. 104 W.,
Sec. 20, SWSE



New: Would be submitted within 30 days of construction or changes
Existing: Within 30 days of assignment of FMP number
Required for all facilities

Well	API N
Fed #1	33007
Fed #2	33007
Fed #3	33007

Compressor data
Manufacturer: A
Rating: 125,000 Btu/hr
Serial #: 00987654321
Monthly volume = 0.125 Mcf/hr x hours used per month

I, Michael Wade, representing Wade Oil Company, certify the accuracy and completeness of the information containted within this site facility diagram

Michael Wade MICHAEL WADE 4/4/2013
Signature Printed Date

Phase	Prod. Valve	Sales Valve
Production	Open	Closed*
Sales	Closed*	Open

*effectively sealed

Gas Variaibility; Dynamic Sampling

Subcommittee on Royalty Management (2007)

"MMS and BLM should develop a procedure to determine the potential BTU variability of produced natural gas on a by-reservoir or by-lease basis, and estimate the implications for royalty payments"

"MMS and BLM should adjust BTU frequency requirements for sampling and reporting on a case by-case basis, or consider other regulatory Requirements"

BLM Gas Variability Study

Data:

- 1895 gas analyses
- 217 meters
- 6 BLM Field Offices

BLM Gas Variability Study

Analysis:

Each meter characterized by:

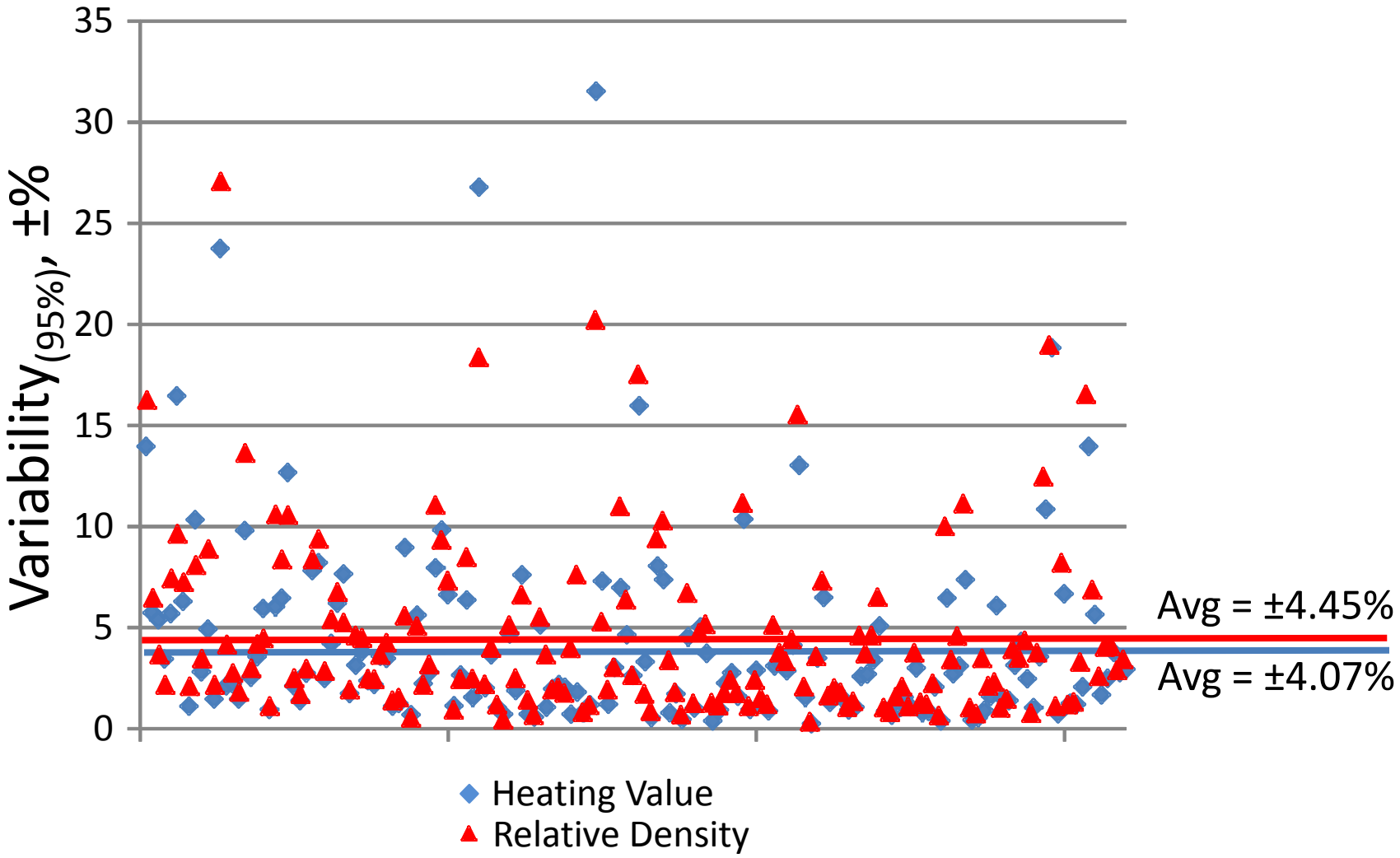
- Heating value (lean, mid, rich);
- Temperature;
- Time of production;
- Pressure;
- Reservoir type (gas cap, tight sand, CBM)
- Type of lift (plunger, free-flow, pumping unit)
- Separator prior to the meter?
- Number of samples

BLM Gas Variability Study

Analysis:

- Calculated variability (95%) for meters > 4 analyses
- Correlate variability to well/meter characteristics

BLM Gas Variability Study - Results



BLM Gas Variability Study

Conclusions:

- No correlation of variability to any characteristic analyzed
- Variability caused by actual variations in gas the gas stream, or…
- Poor sampling and analysis?
- Fixed sampling frequency would be arbitrary and would not necessarily achieve heating value uncertainty requirements
- Assuming variability is random (uncorrelated)…

BLM Gas Variability Study

$$U_{\overline{HV}} \approx V_{95\%} \times \frac{1}{\sqrt{N}}$$

$U_{\overline{HV}}$ = Uncertainty of avg heating value, %

$V_{95\%}$ = Historic variability of heating value, %

N = number of samples

- Sampling frequency would be calculated on a per-meter basis, based on historic variability of heating value for that FMP:

$$P_s = 365\left(\frac{U}{0.951 \times V_{95\%}}\right)^2$$

U = required heating value uncertainty

P_s = days to next sample

$V_{95\%}$ = variability of last 5 samples

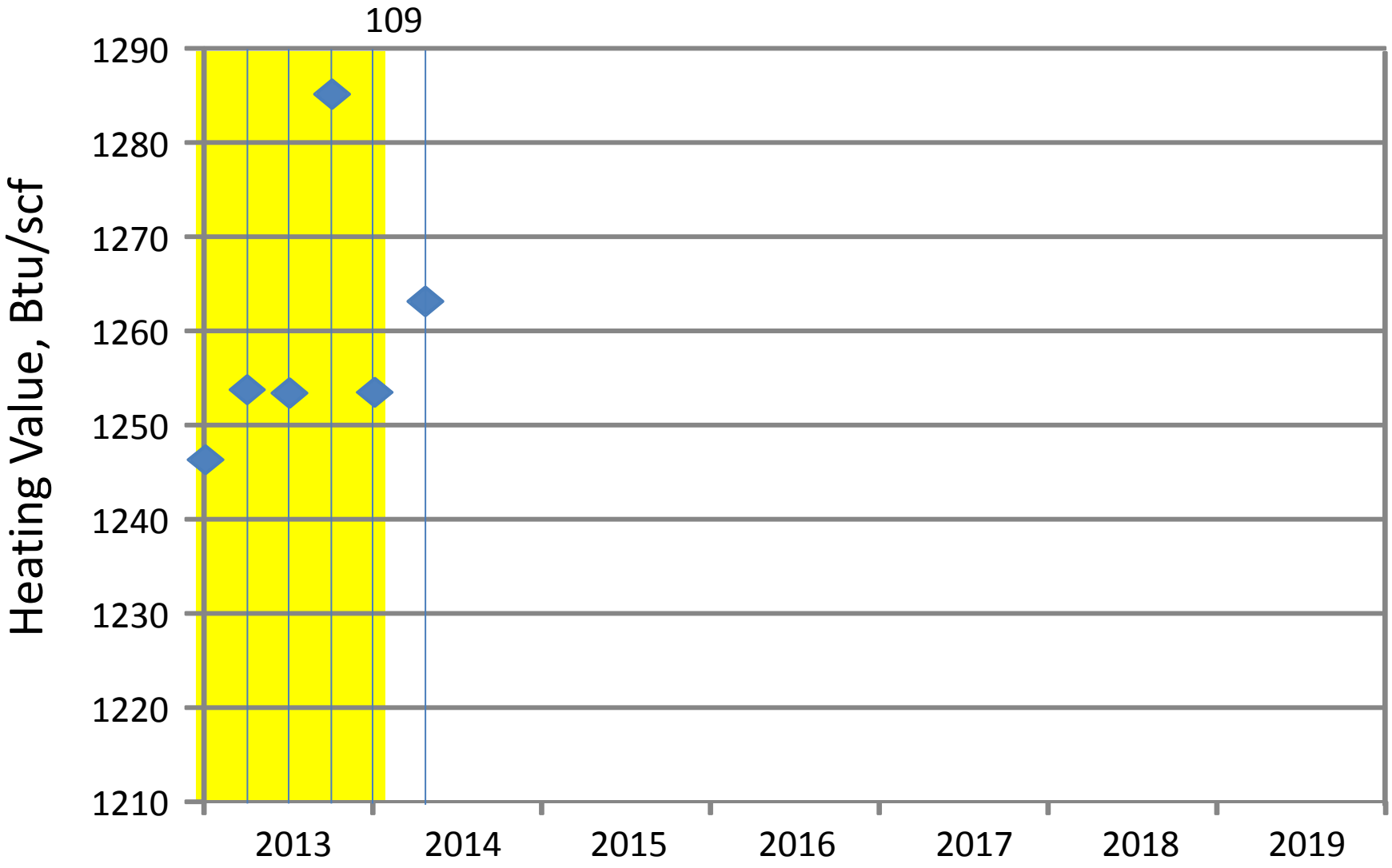
- Frequency would change with variability

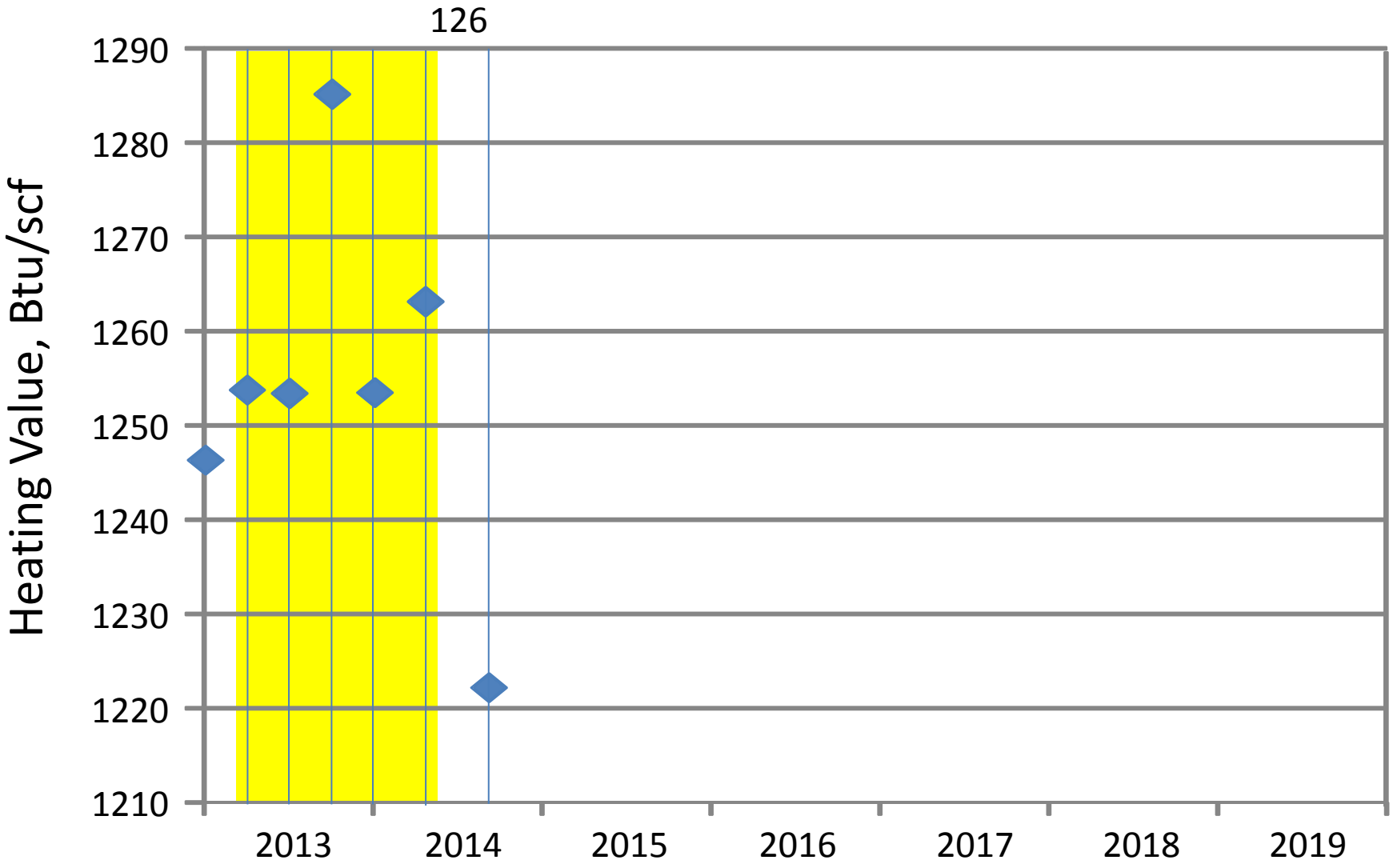
Implementation

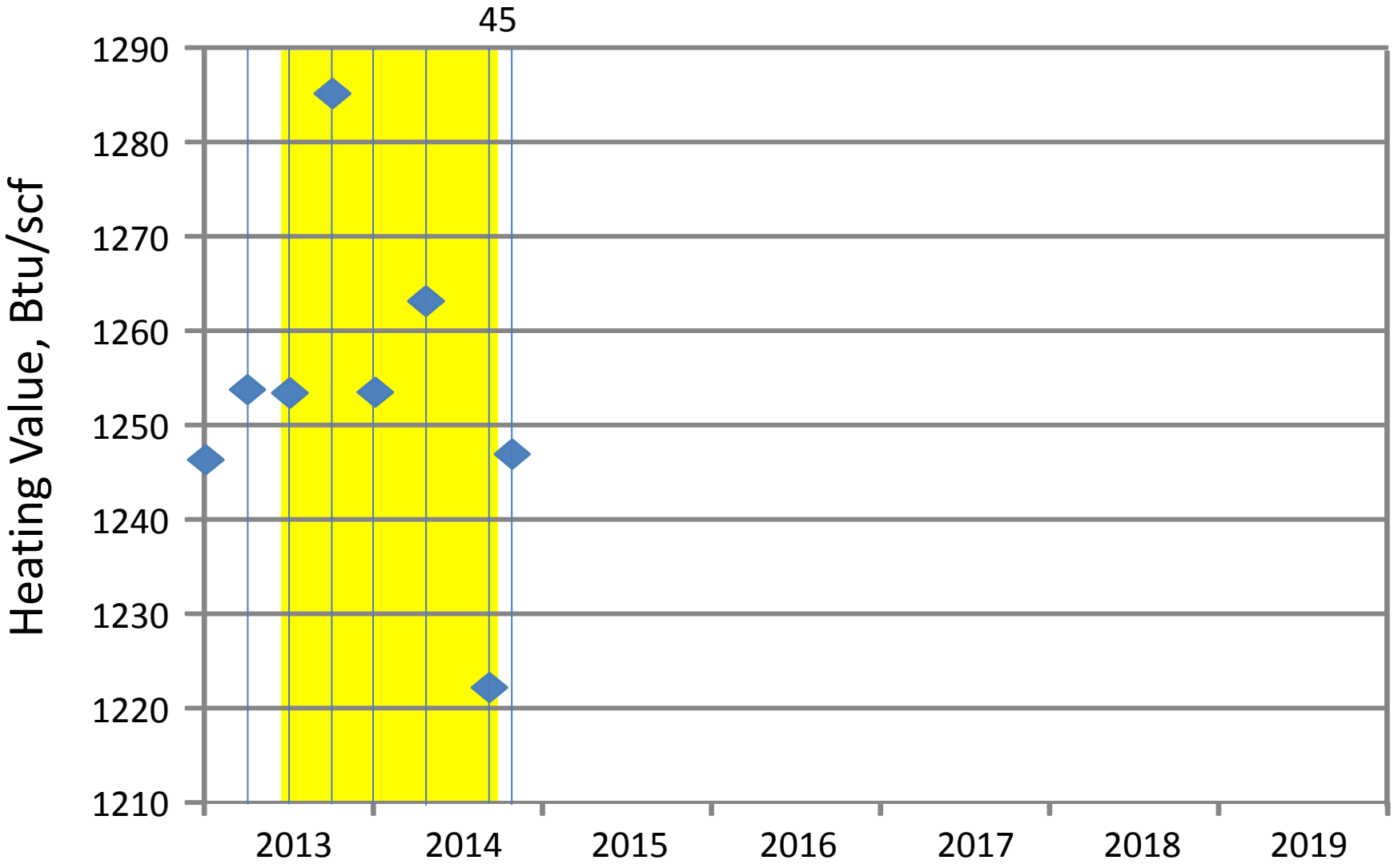
- Would require software to implement
- All gas analyses submitted to BLM electronically
- Next sample due date would be calculated and sent to the operator
- Composite sampling or on-line GC would eliminate sampling frequency requirement
- Minimum sampling frequency would be annual

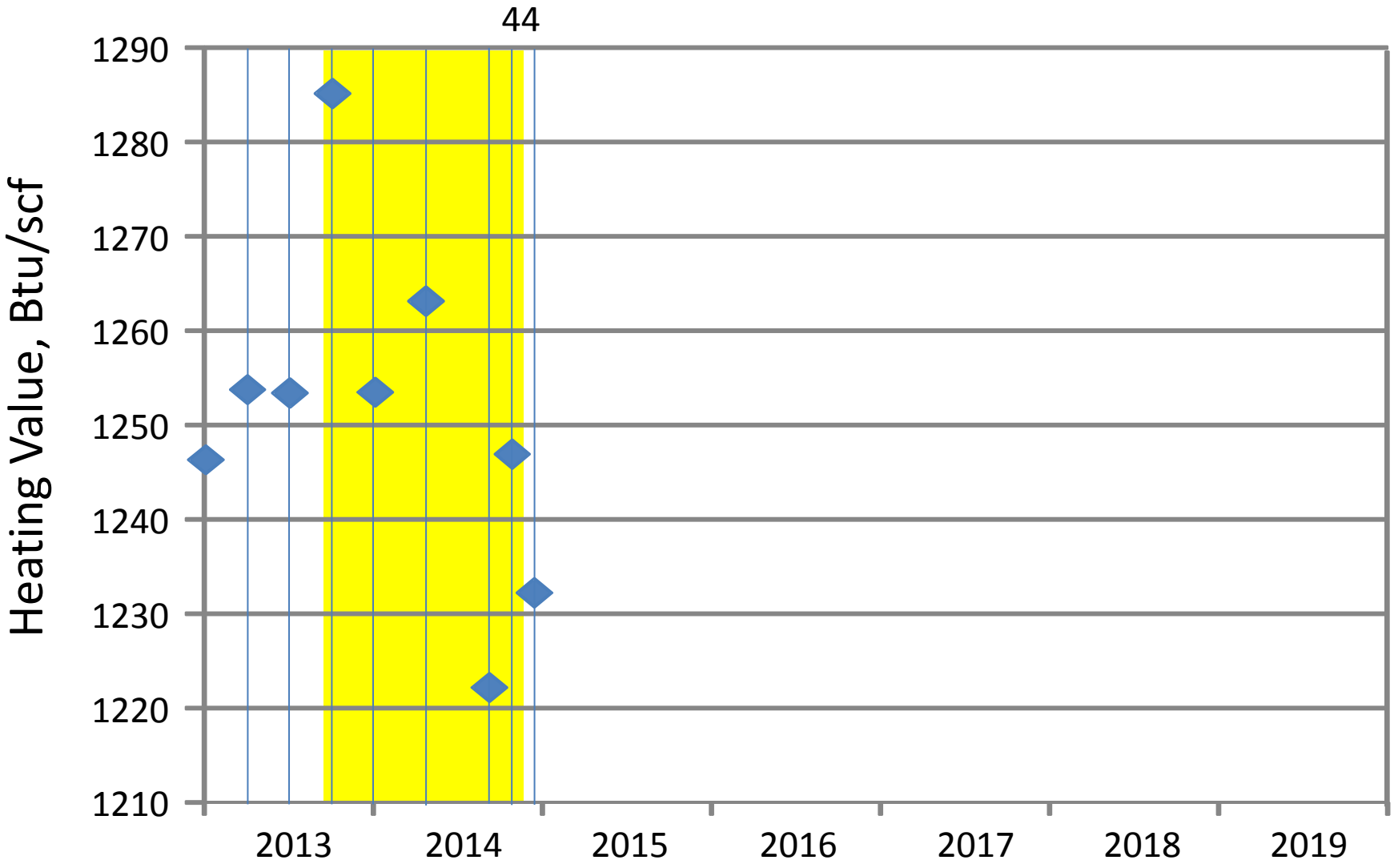
Advantages

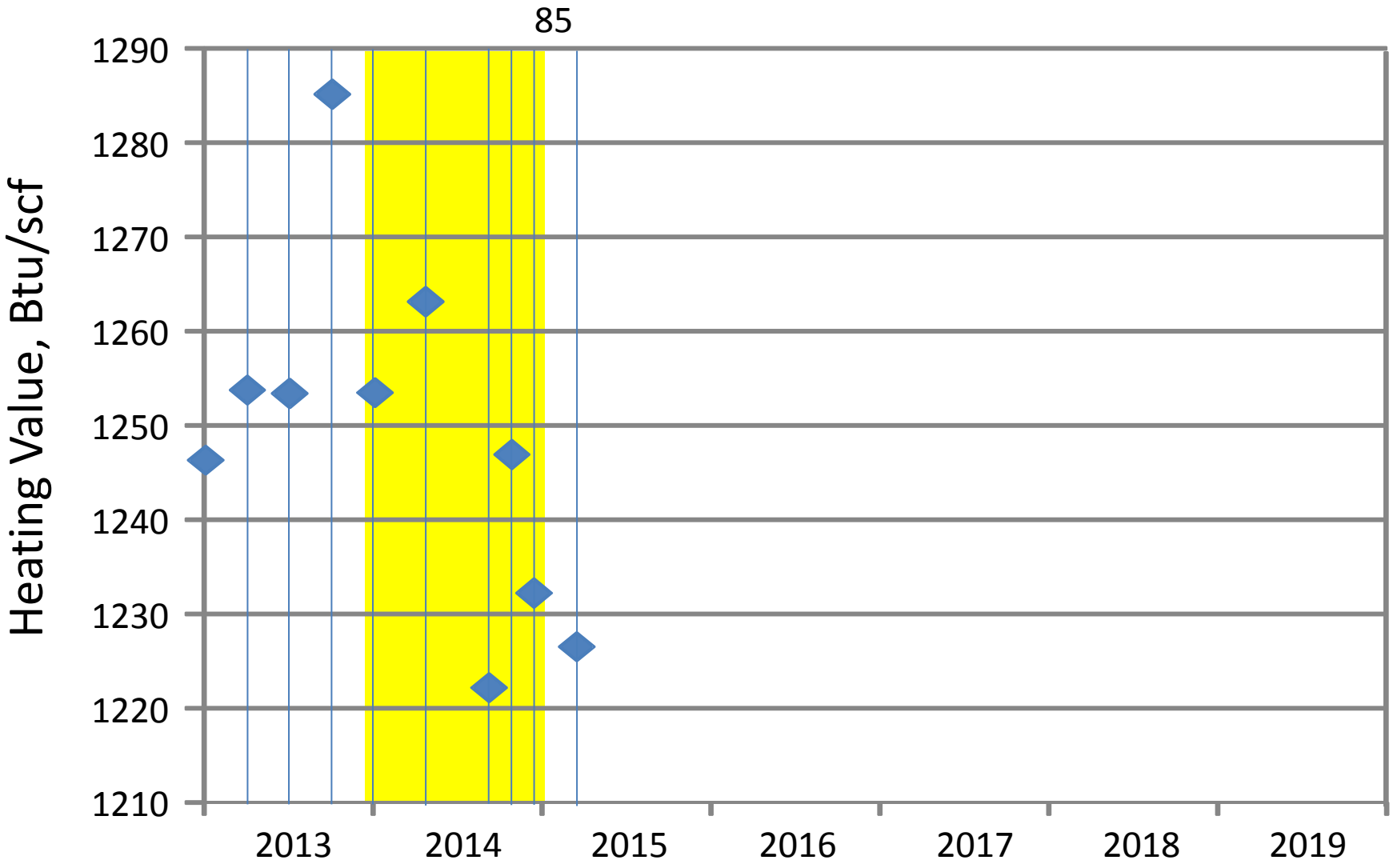
- Would achieve a consistent level of uncertainty
- Changes in variability would result in changes to sampling frequency
- Relative density uncertainty would be used in the calculation of flow rate uncertainty (Uncertainty Calculator)
- Would provide economic incentive for good sampling and analysis

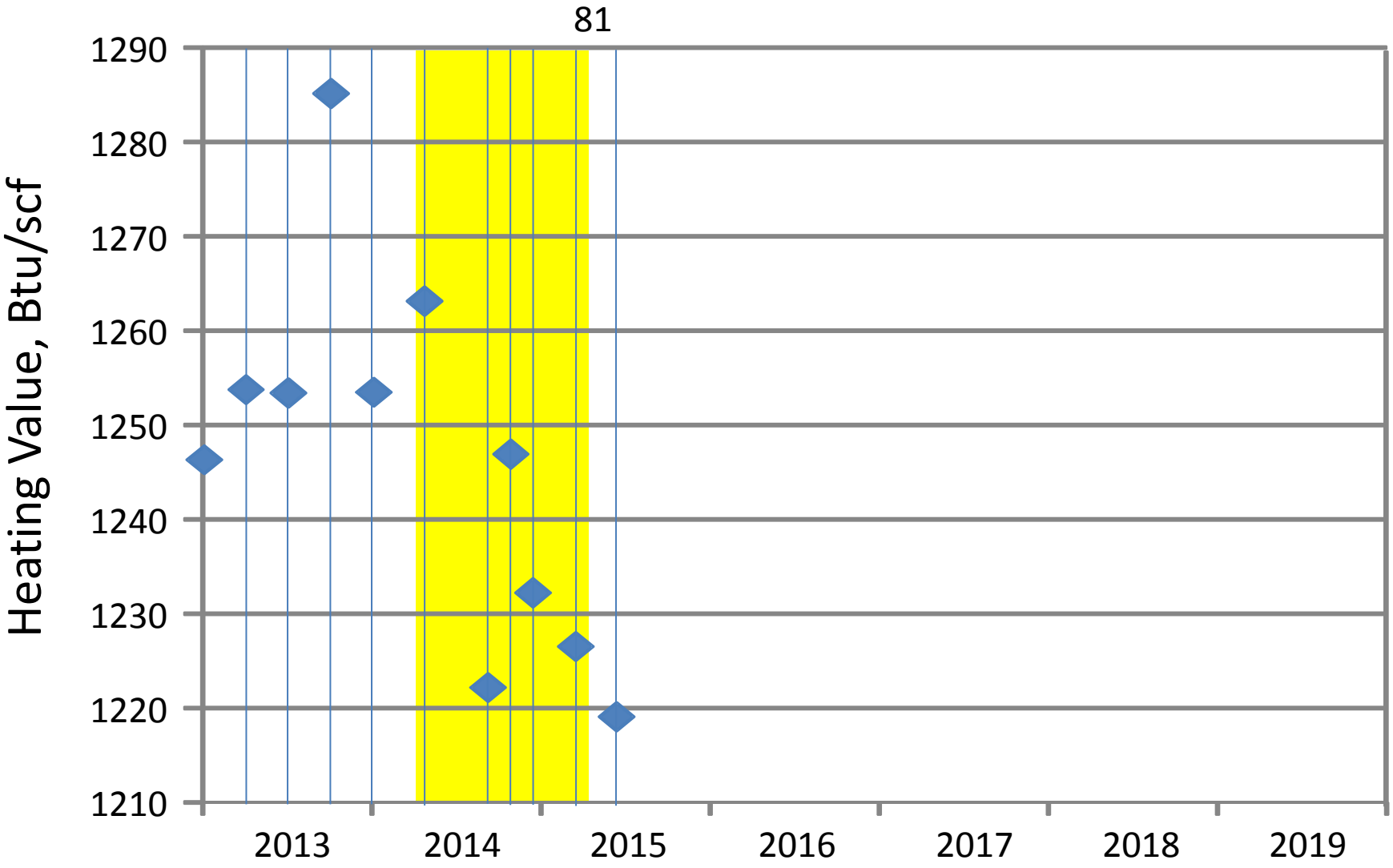

109
Heating Value, Btu/scf
1290
1280
1270
1260
1250
1240
1230
1220
1210
2013
2014
2015
2016
2017
2018
2019

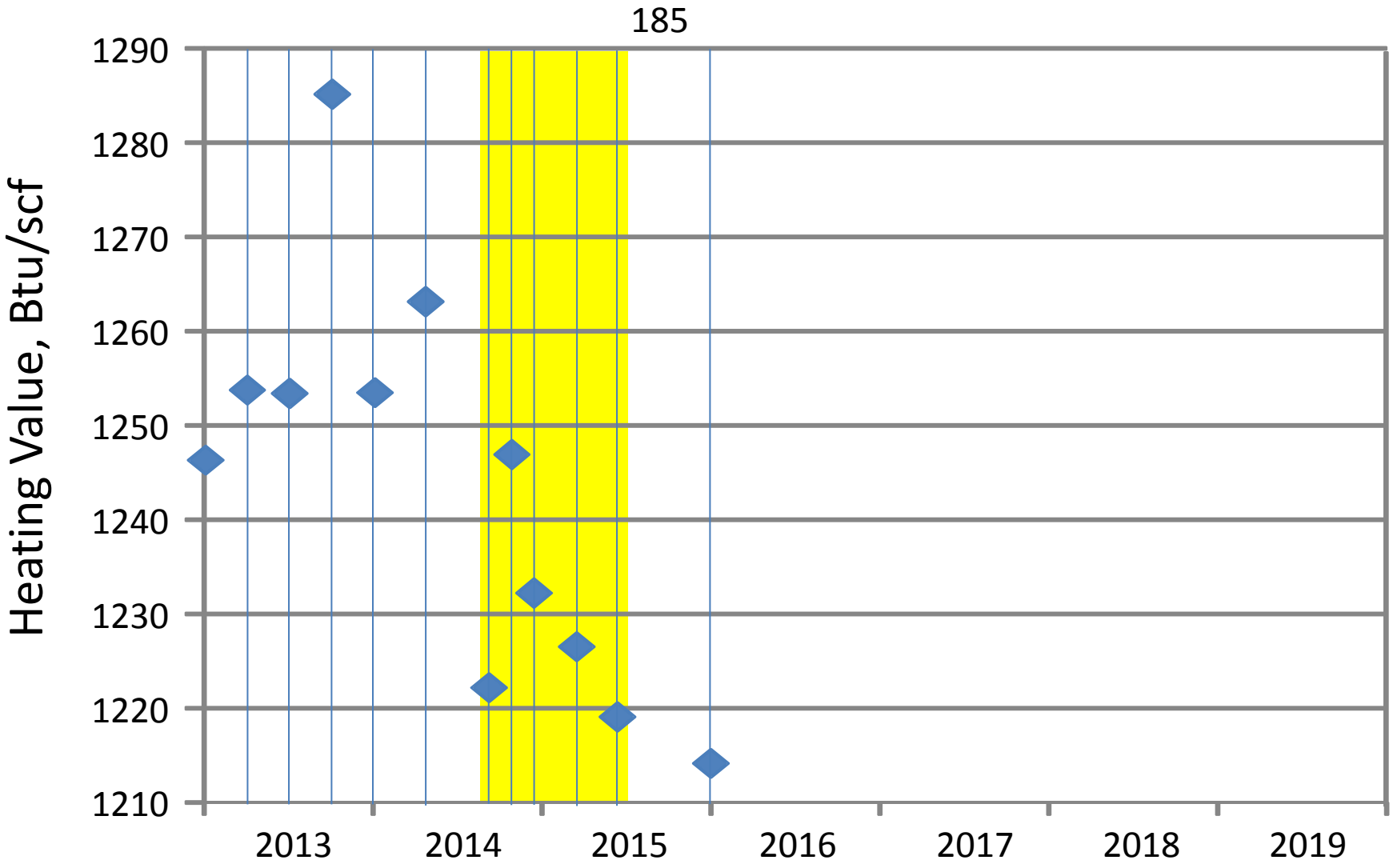

126
Heating Value, Btu/scf
1290
1280
1270
1260
1250
1240
1230
1220
1210
2013
2014
2015
2016
2017
2018
2019

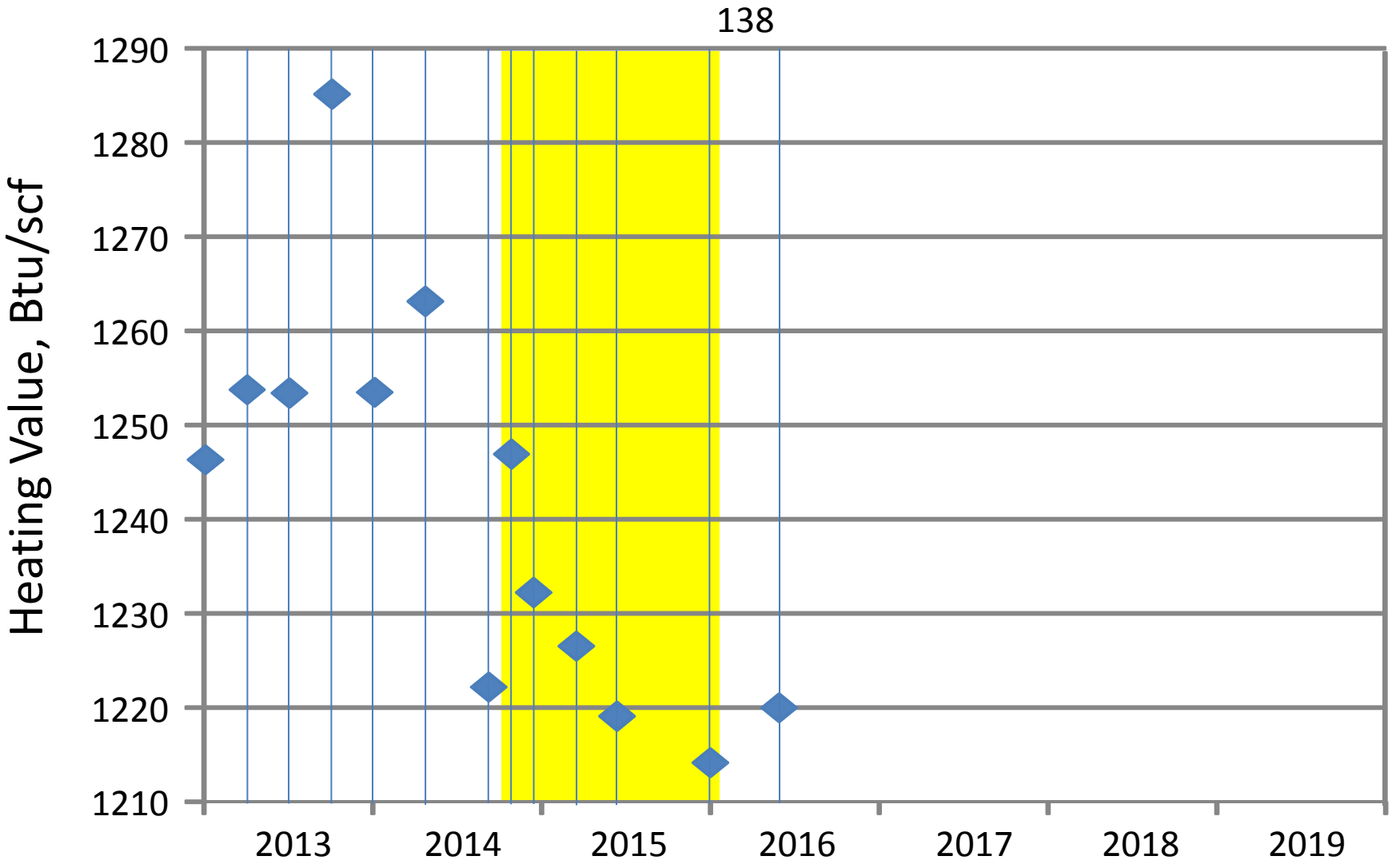

45
Heating Value, Btu/scf
1290
1280
1270
1260
1250
1240
1230
1220
1210
2013
2014
2015
2016
2017
2018
2019

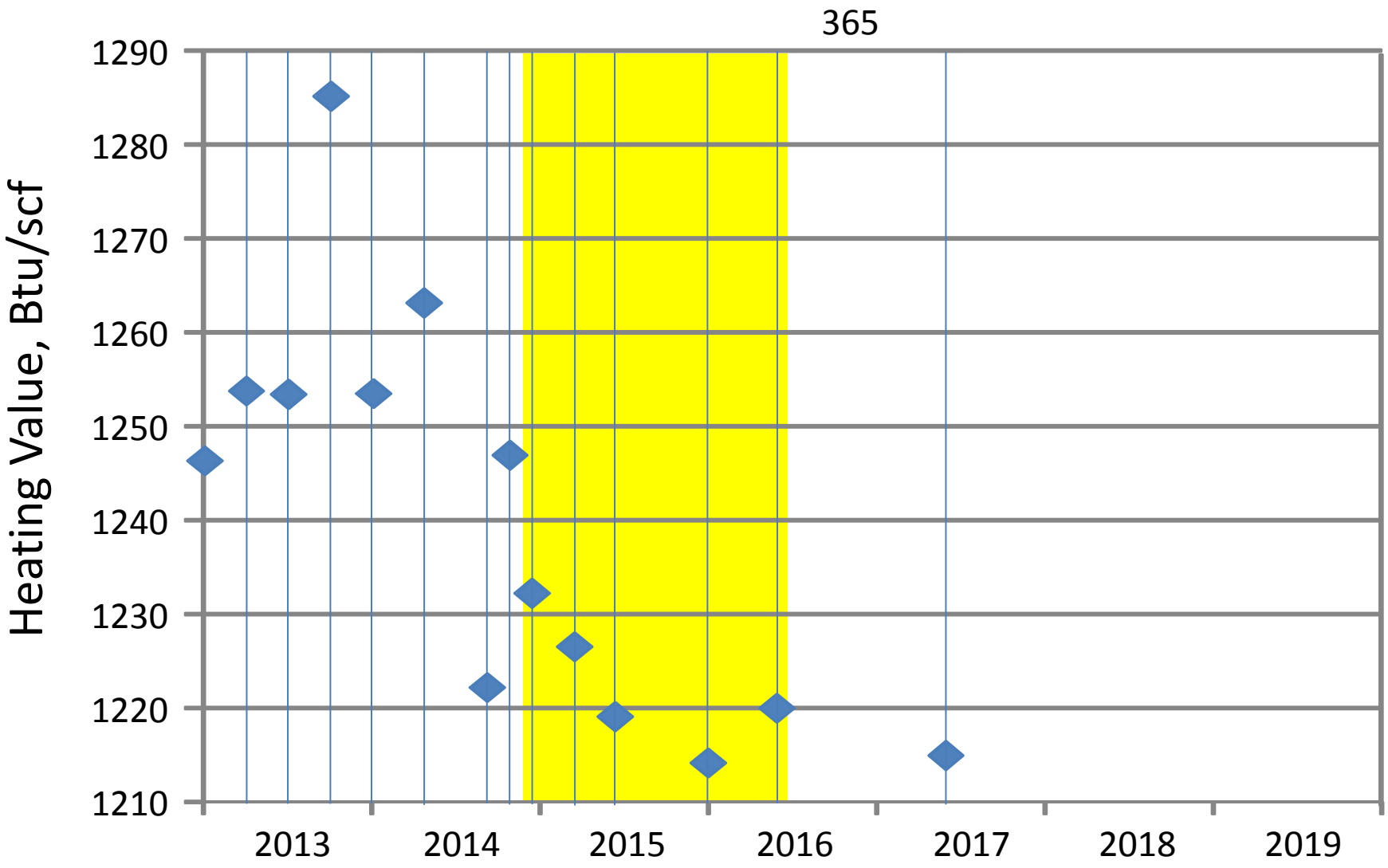

44
Heating Value, Btu/scf
1290
1280
1270
1260
1250
1240
1230
1220
1210
2013
2014
2015
2016
2017
2018
2019

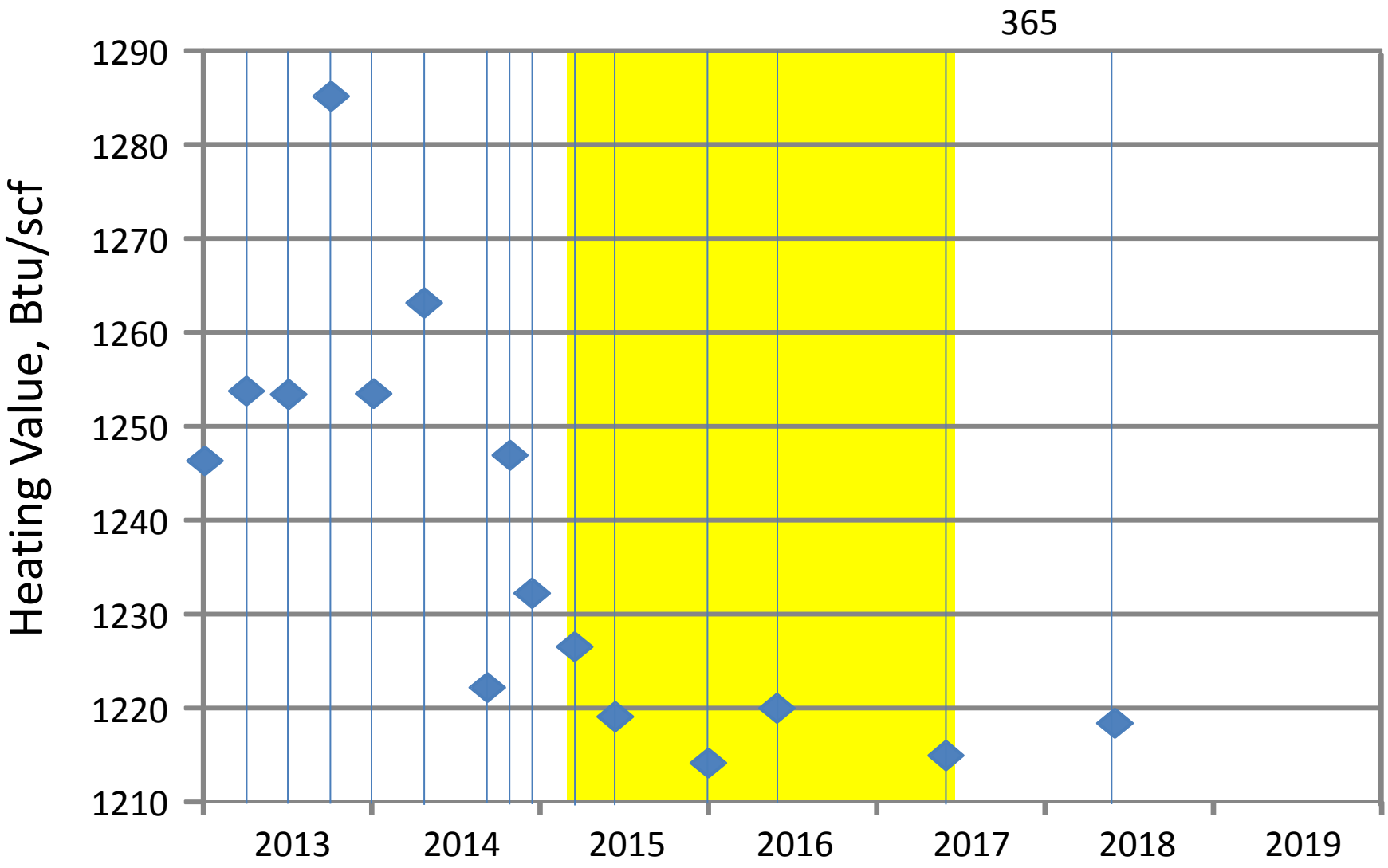

85
Heating Value, Btu/scf
1290
1280
1270
1260
1250
1240
1230
1220
1210
2013
2014
2015
2016
2017
2018
2019


Heating Value, Btu/scf
1290
1280
1270
1260
1250
1240
1230
1220
1210
2013
2014
2015
2016
2017
2018
2019


185
Heating Value, Btu/scf
1290
1280
1270
1260
1250
1240
1230
1220
1210
2013
2014
2015
2016
2017
2018
2019


138
Heating Value, Btu/scf
1290
1280
1270
1260
1250
1240
1230
1220
1210
2013
2014
2015
2016
2017
2018
2019


365
Heating Value, Btu/scf
1290
1280
1270
1260
1250
1240
1230
1220
1210
2013
2014
2015
2016
2017
2018
2019


365
Heating Value, Btu/scf
1290
1280
1270
1260
1250
1240
1230
1220
1210
2013
2014
2015
2016
2017
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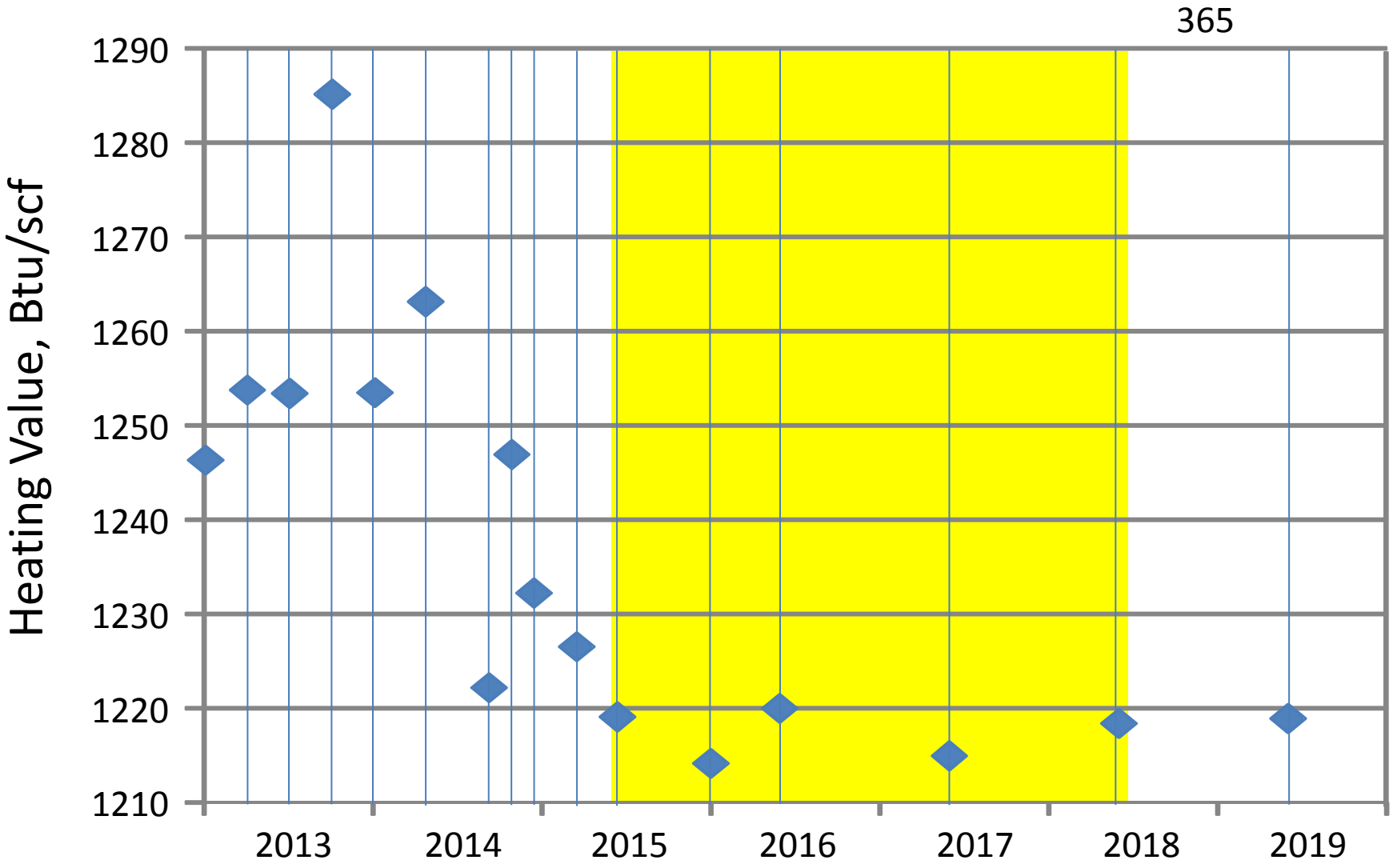
2019


365
Heating Value, Btu/scf
1290
1280
1270
1260
1250
1240
1230
1220
1210
2013
2014
2015
2016
2017
2018
2019

Basis for “tier” thresholds

Low-Volume Exceptions – Proposed Revision

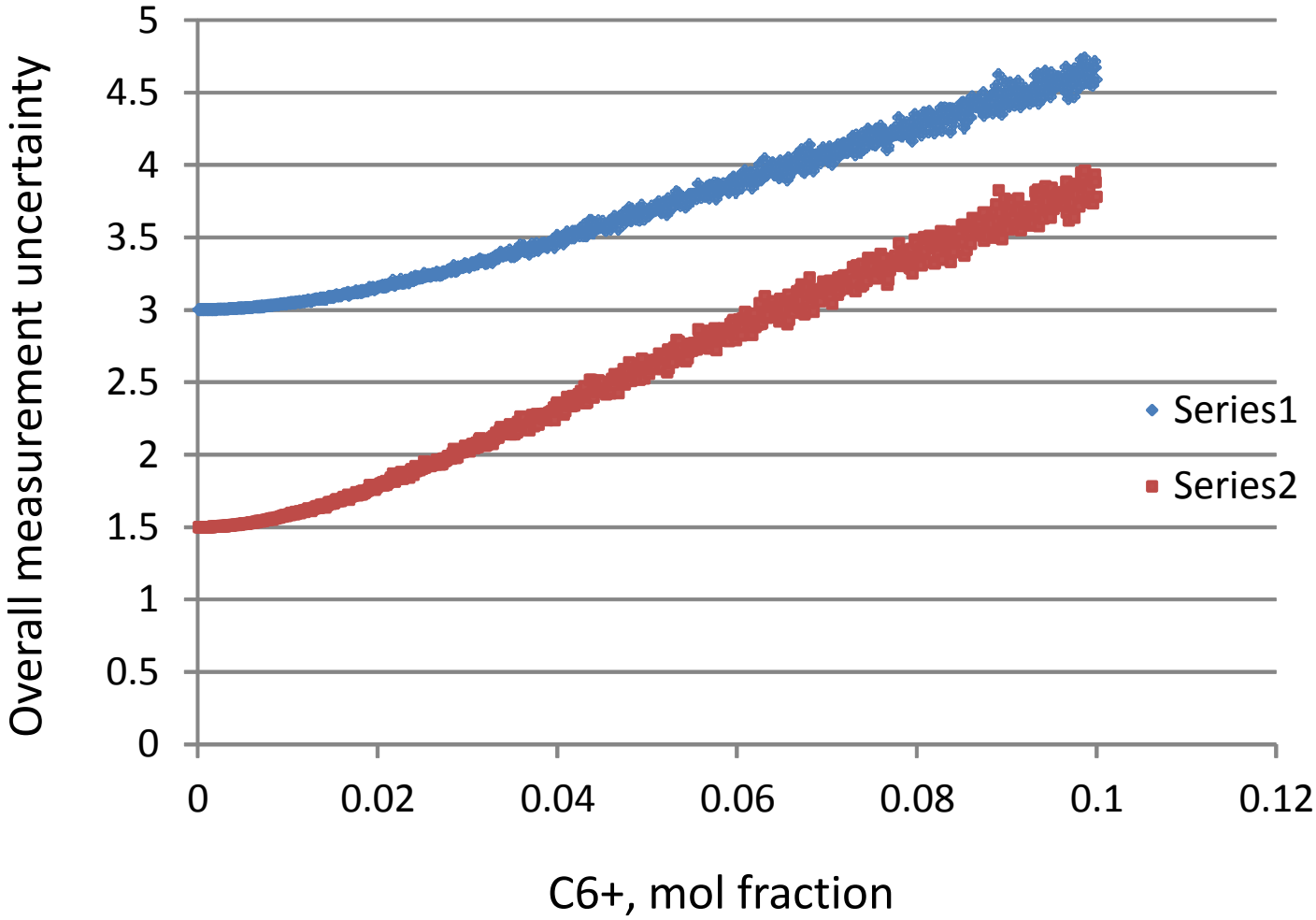
Avg. Monthly Flow, Mcf/day

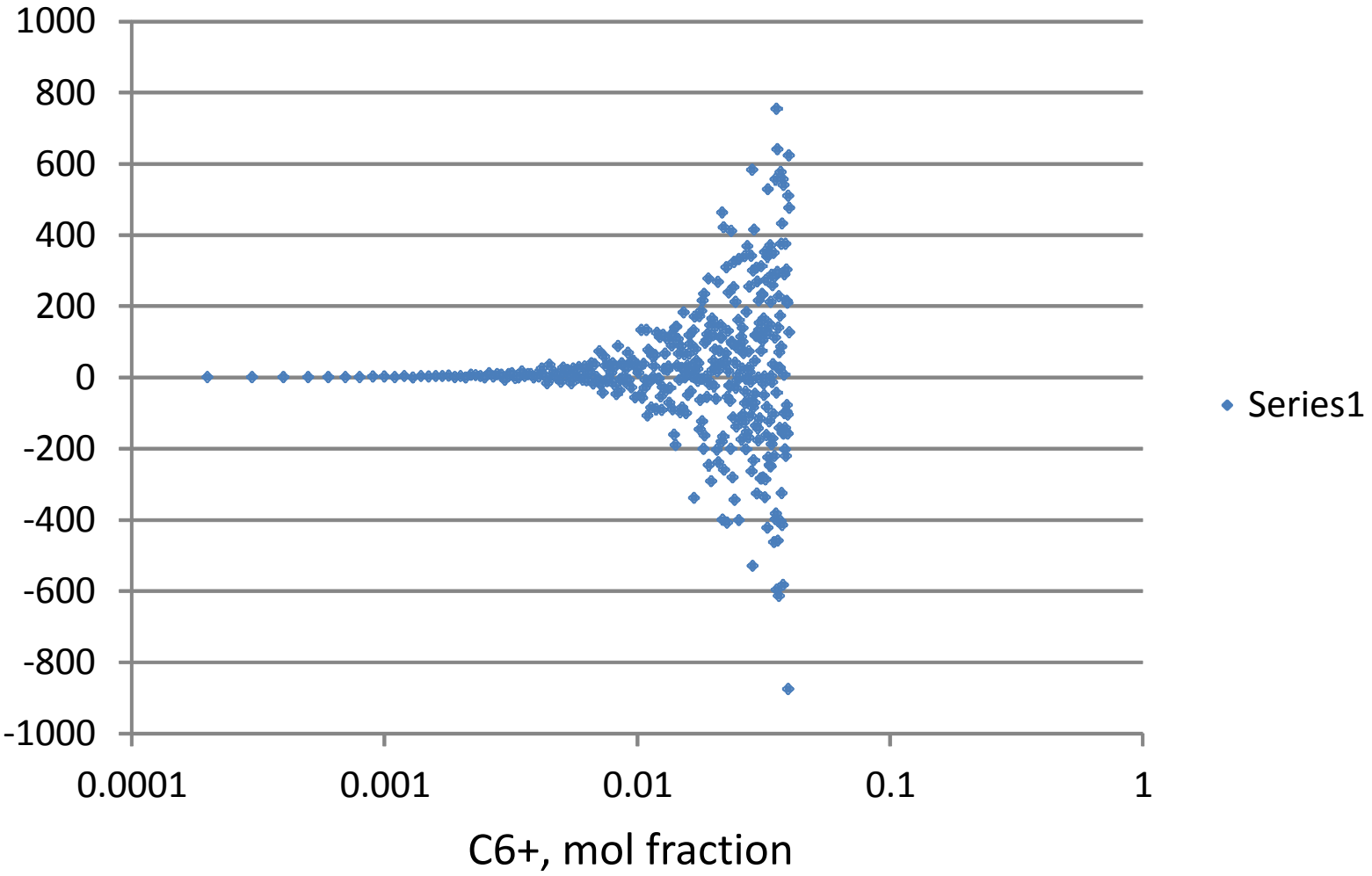
	Uncertainty		Bias*	Verif.
	Volume	HV		
Very High Volume (1000)	±1.5%	±0.5%	~0	yes
High Volume (100)	±3.0%	±1.7%	~0	yes
Low Volume (15)	n/a	n/a	~0	yes
Marginal (0)	n/a	n/a	n/a	yes

C_6+ trigger levels for C_9+ analysis

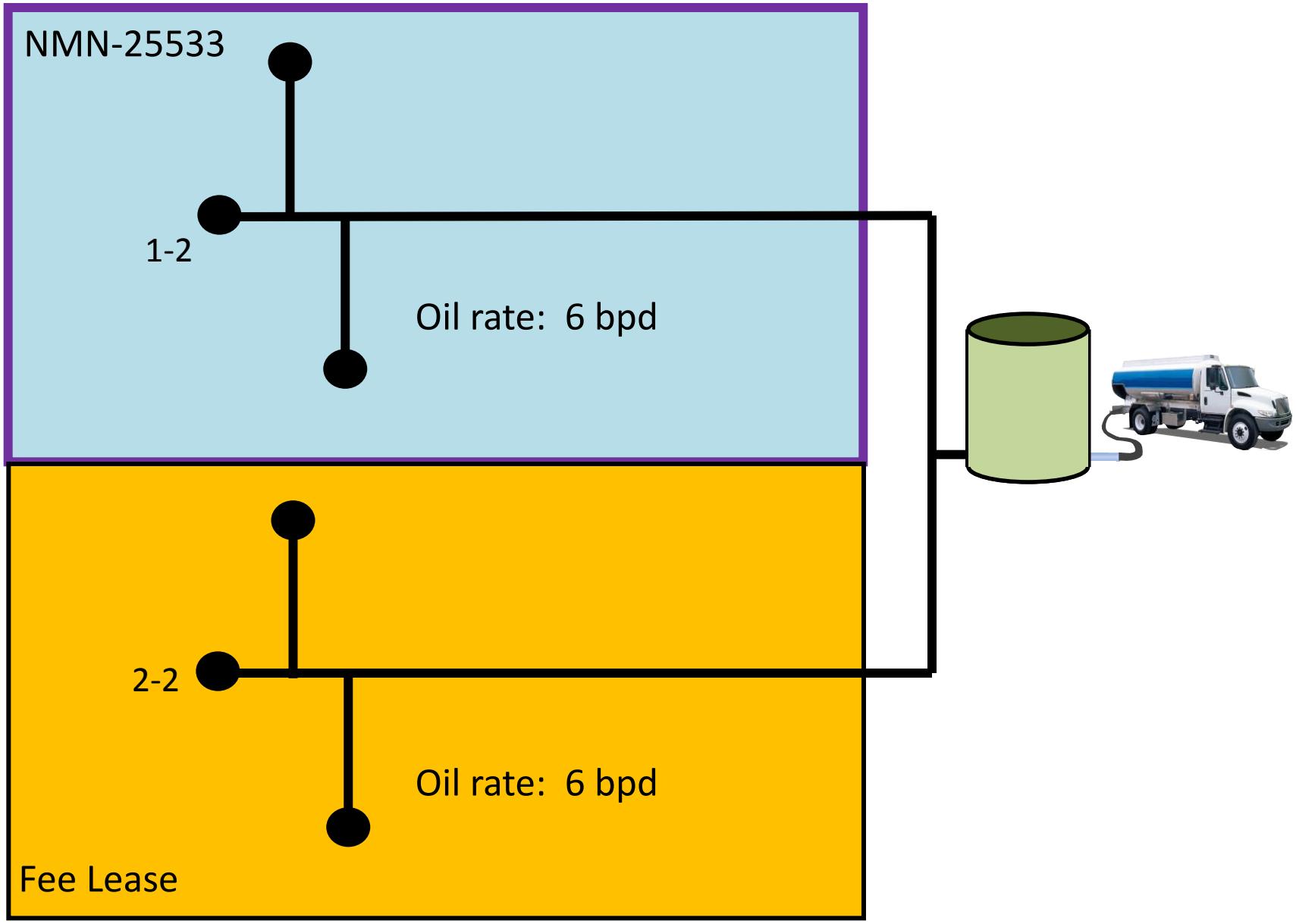
Assuming C_6+ =

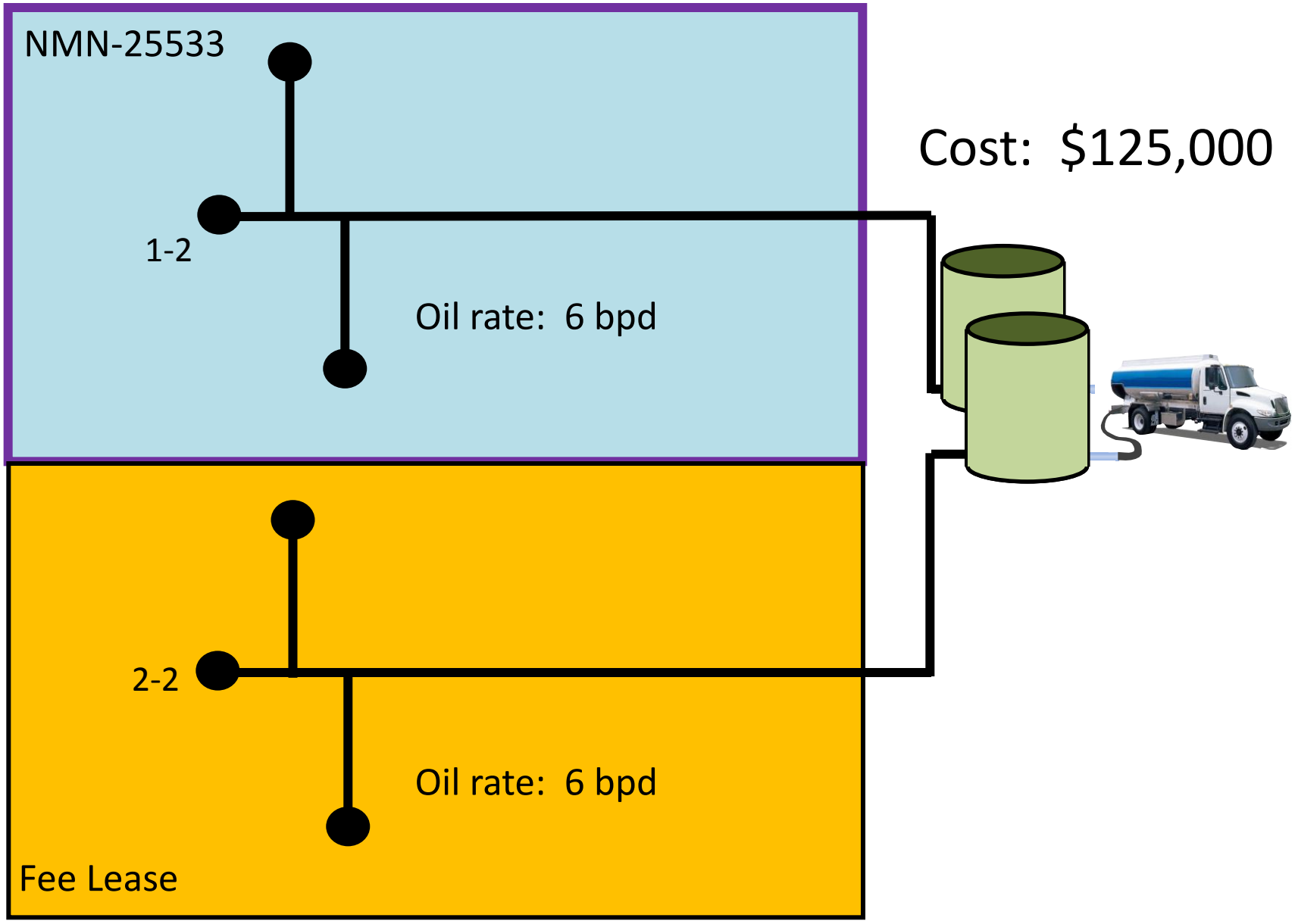
- 60 mol% C_6
- 30 mol% C_7
- 10 mol% C_8


Overall measurement uncertainty
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
0.02
0.04
0.06
0.08
0.1
0.12
C6+, mol fraction
Series1
Series2

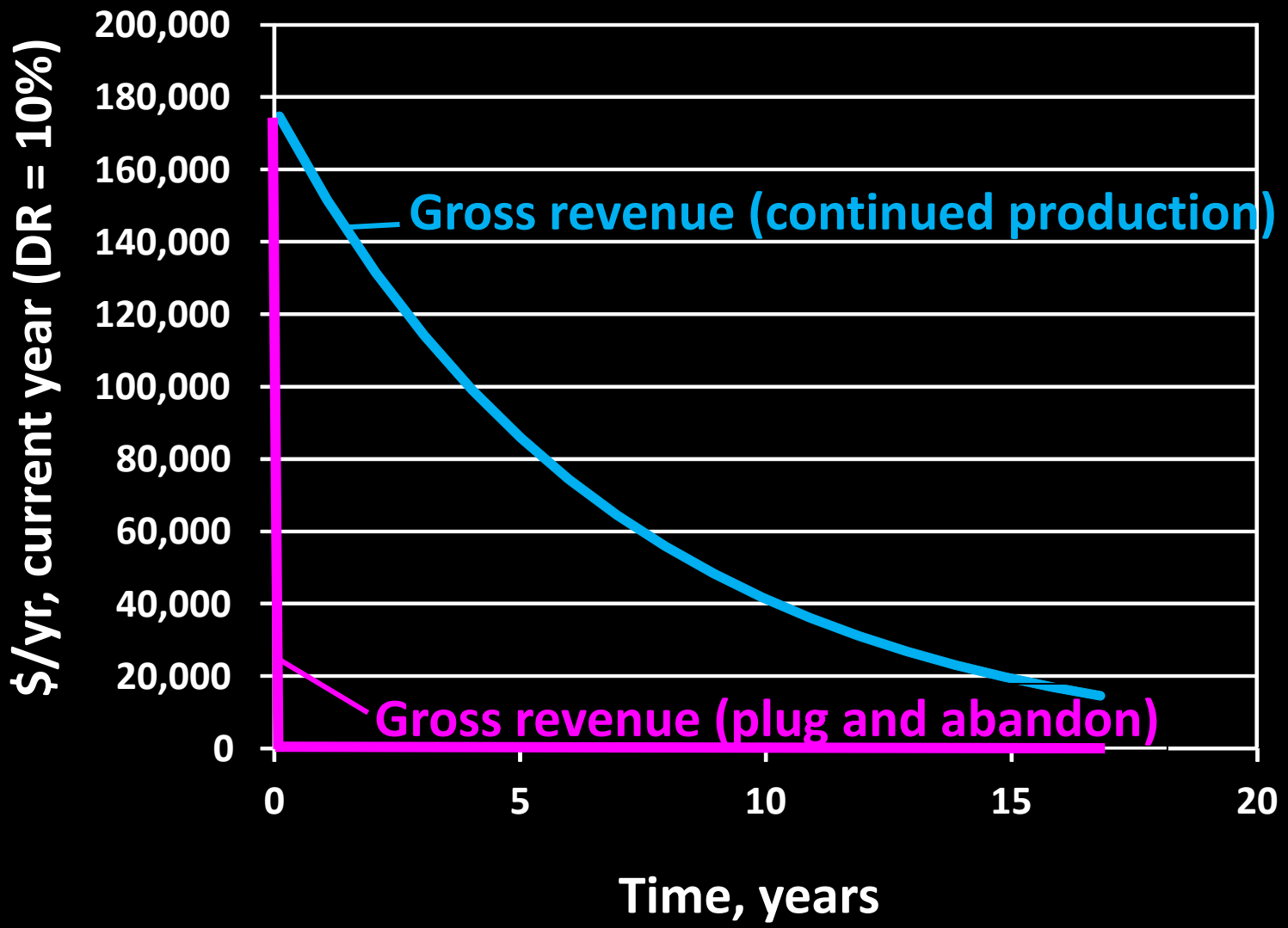

1000
800
600
400
200
0
-200
-400
-600
-800
-1000
0.0001
0.001
0.01
0.1
1
C6+, mol fraction
Series1

Economic Test for Commingling

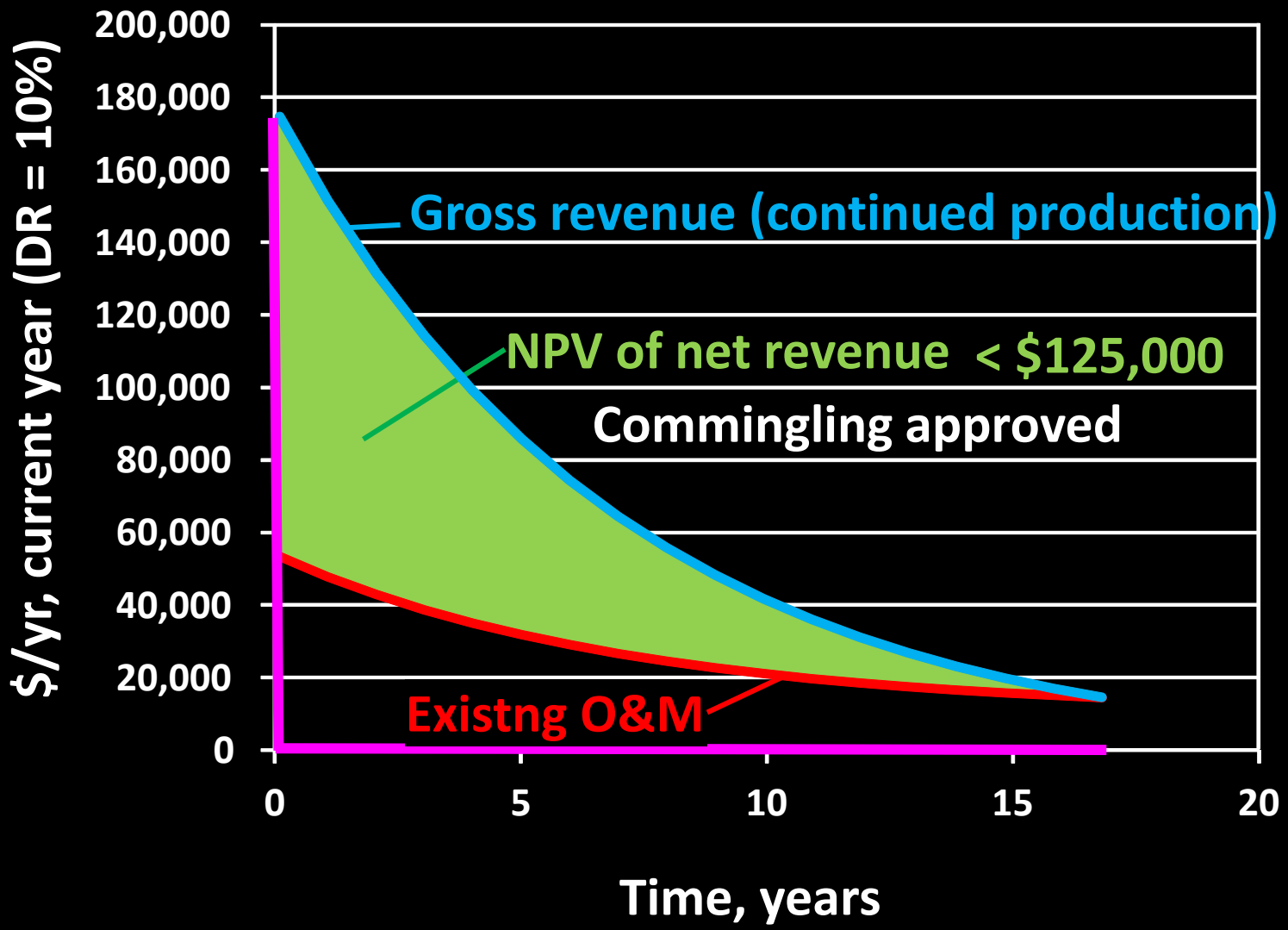

NMN-25533
1-2
Oil rate: 6 bpd
2-2
Oil rate: 6 bpd
Fee Lease


NMN-25533
1-2
Oil rate: 6 bpd
Cost: $125,000
2-2
Oil rate: 6 bpd
Fee Lease

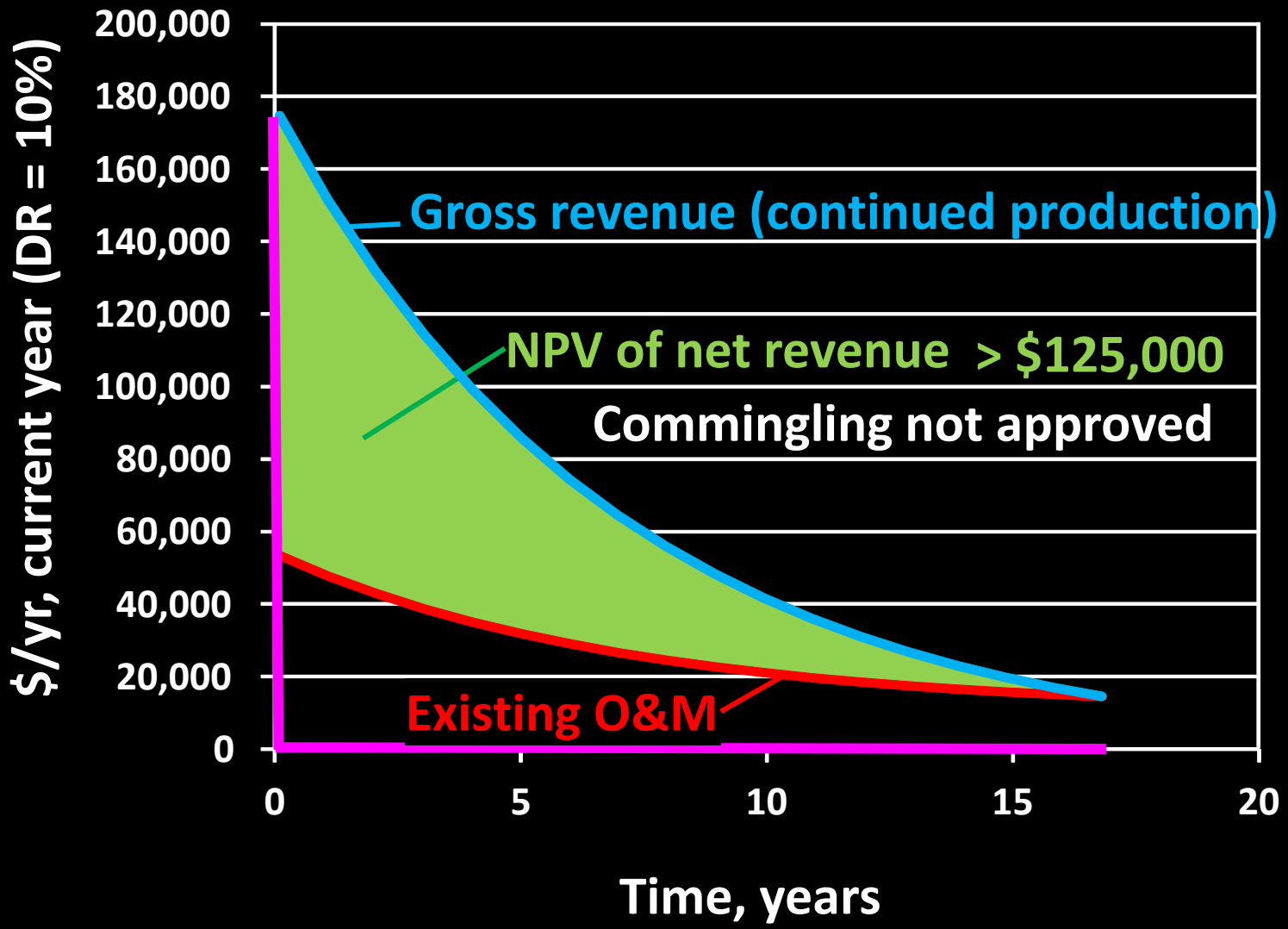
Test 1: Return on Investment



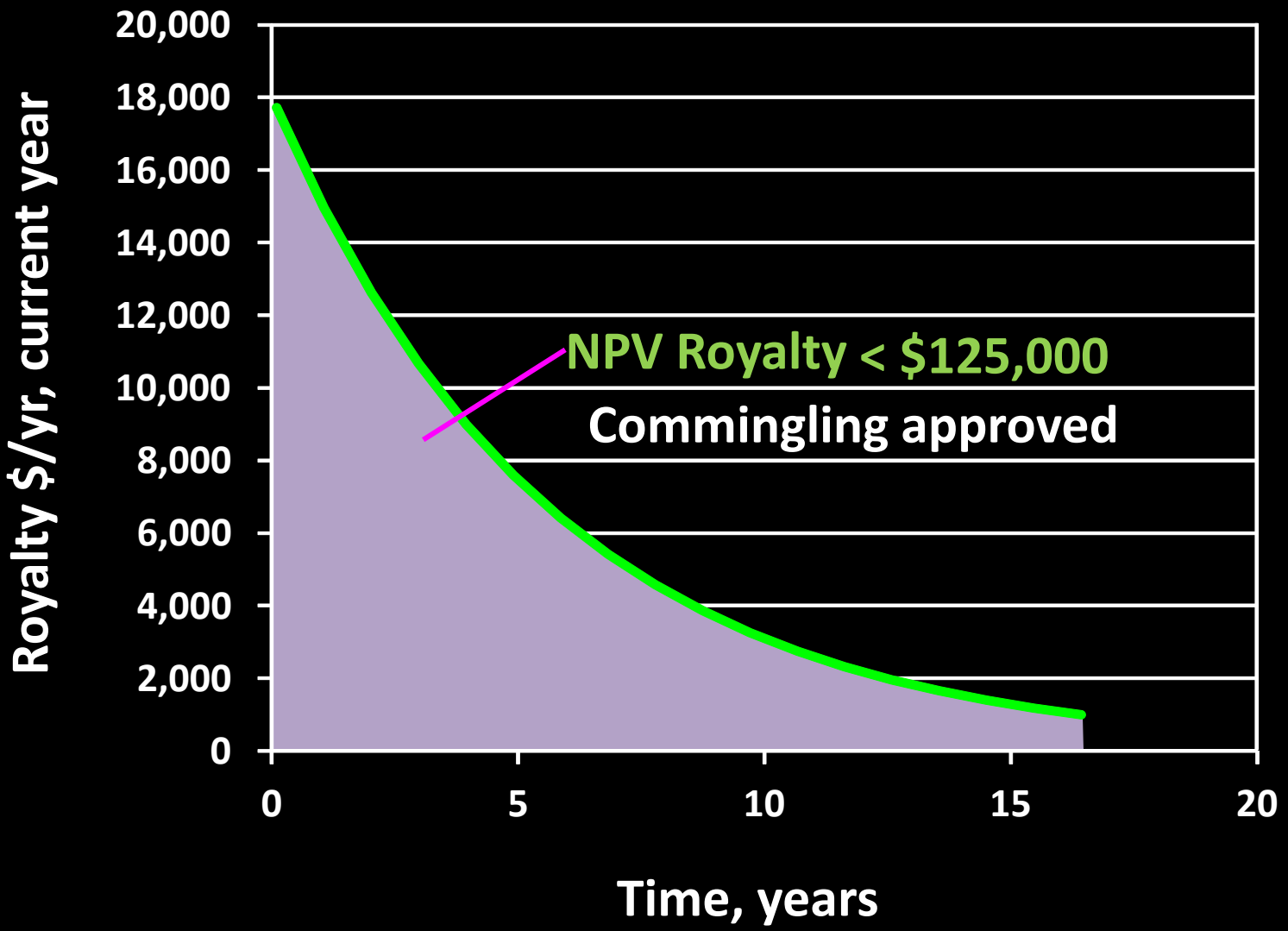
Test 1: Return on Investment



Test 1: Return on Investment



Test 2: NPV Royalty



Off-lease Measurement

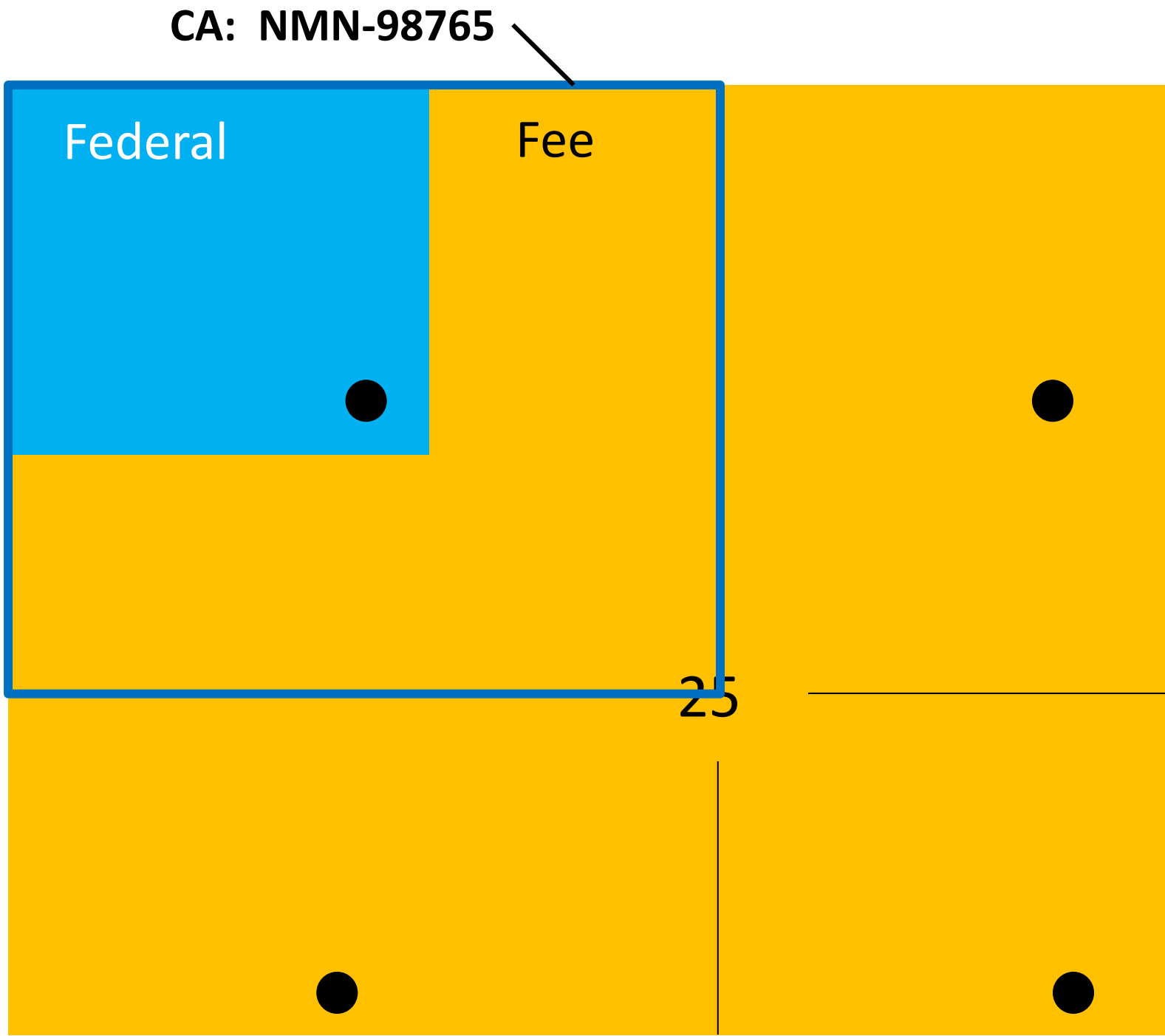
Off-lease Measurement – Existing

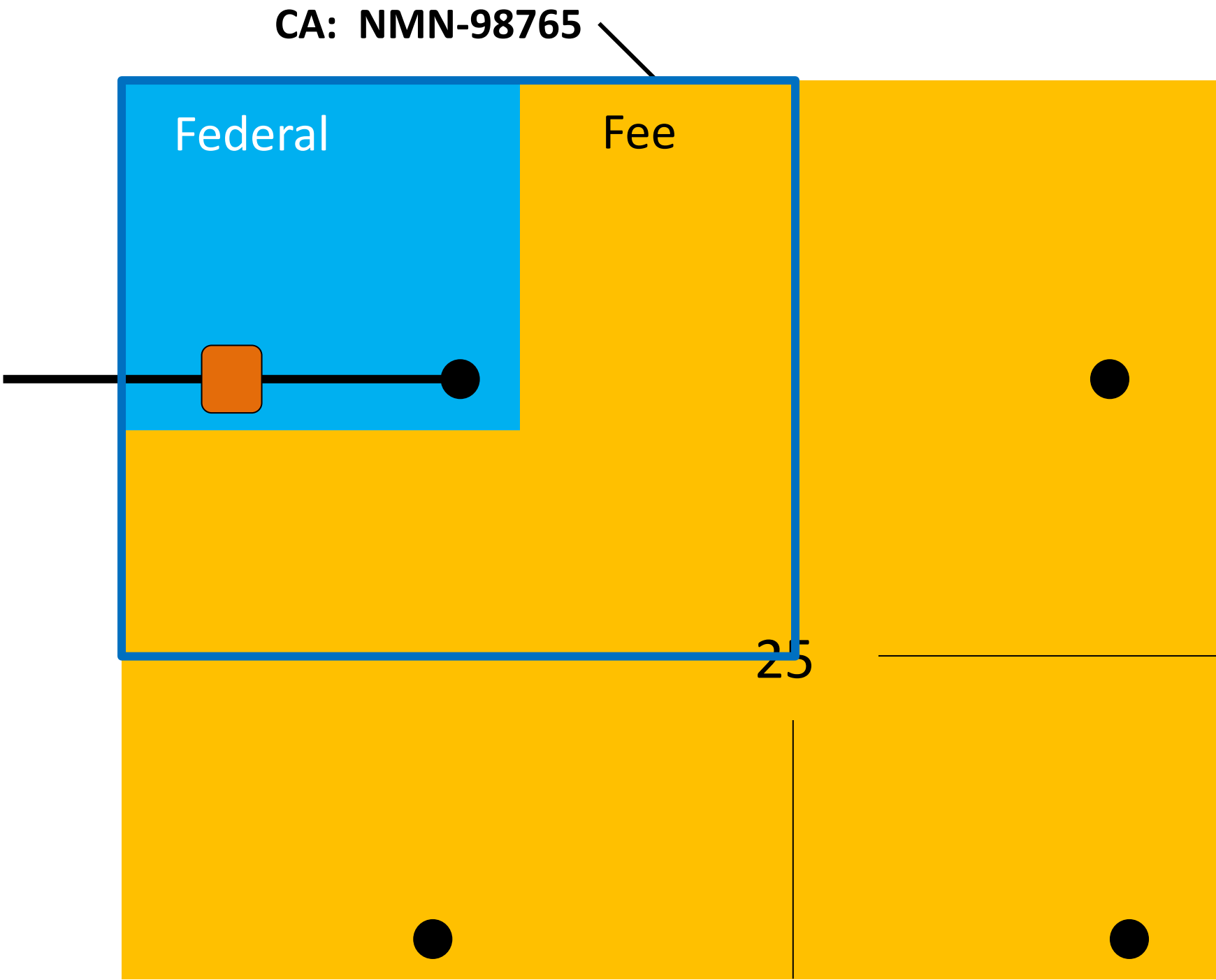
- "All oil [gas] production shall be measured on the lease….off lease… measurement…may be approved by the authorized officer" [*43 CFR 3162.7-2&3*]
- IM 2011-184 provides guidance to Field Offices on how to review applications

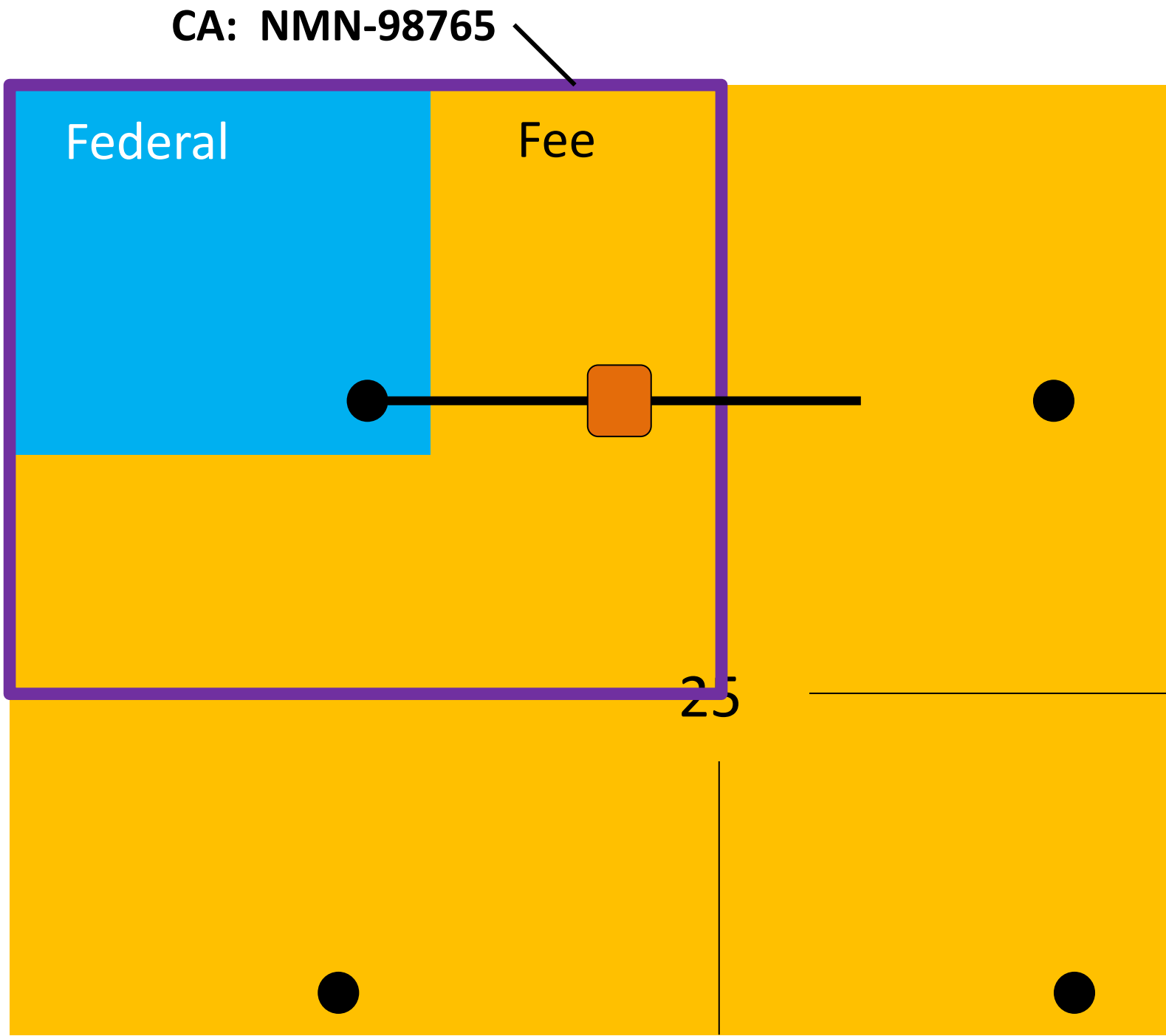
Off-lease Measurement – Proposed Revision

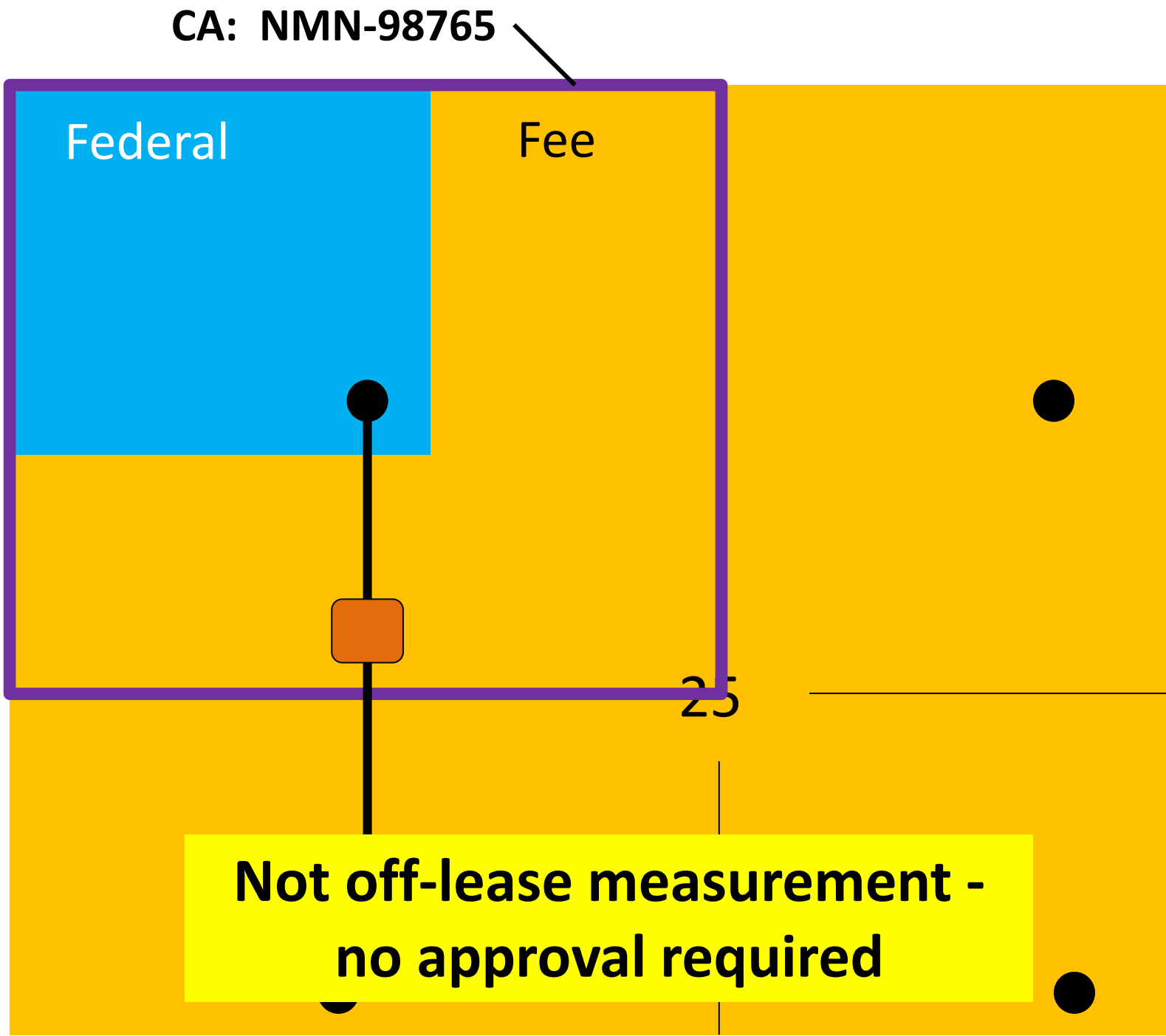
Off-lease measurement would only be allowed if:

- Measurement for a single lease, CA, or PA
- Provide for production accountability
  - Accessibility for the BLM
  - Site security between lease line and FMP
- Public interest
  - Environmental considerations
  - Maximum ultimate recovery

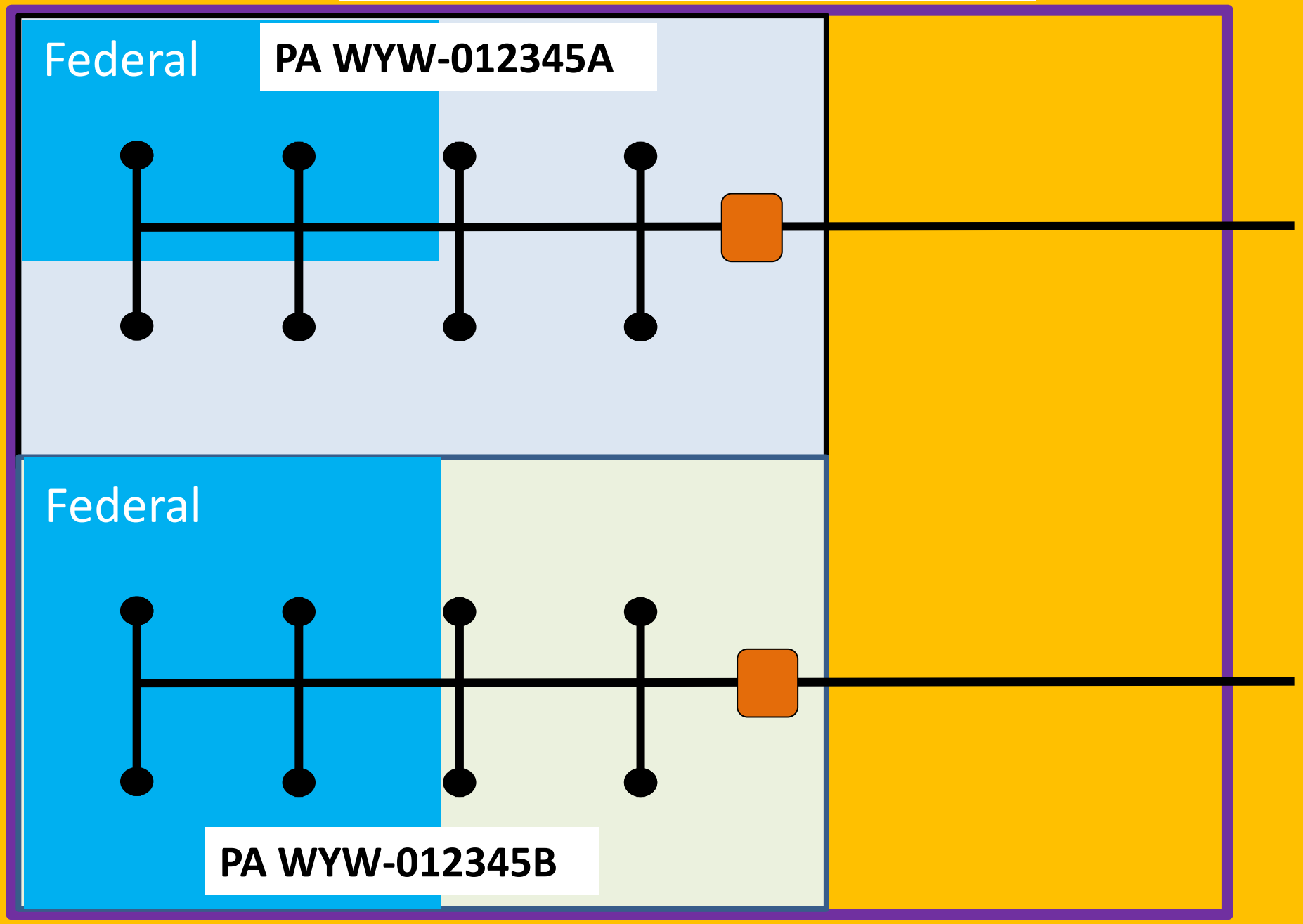

CA: NMN-98765
Federal
Fee
25

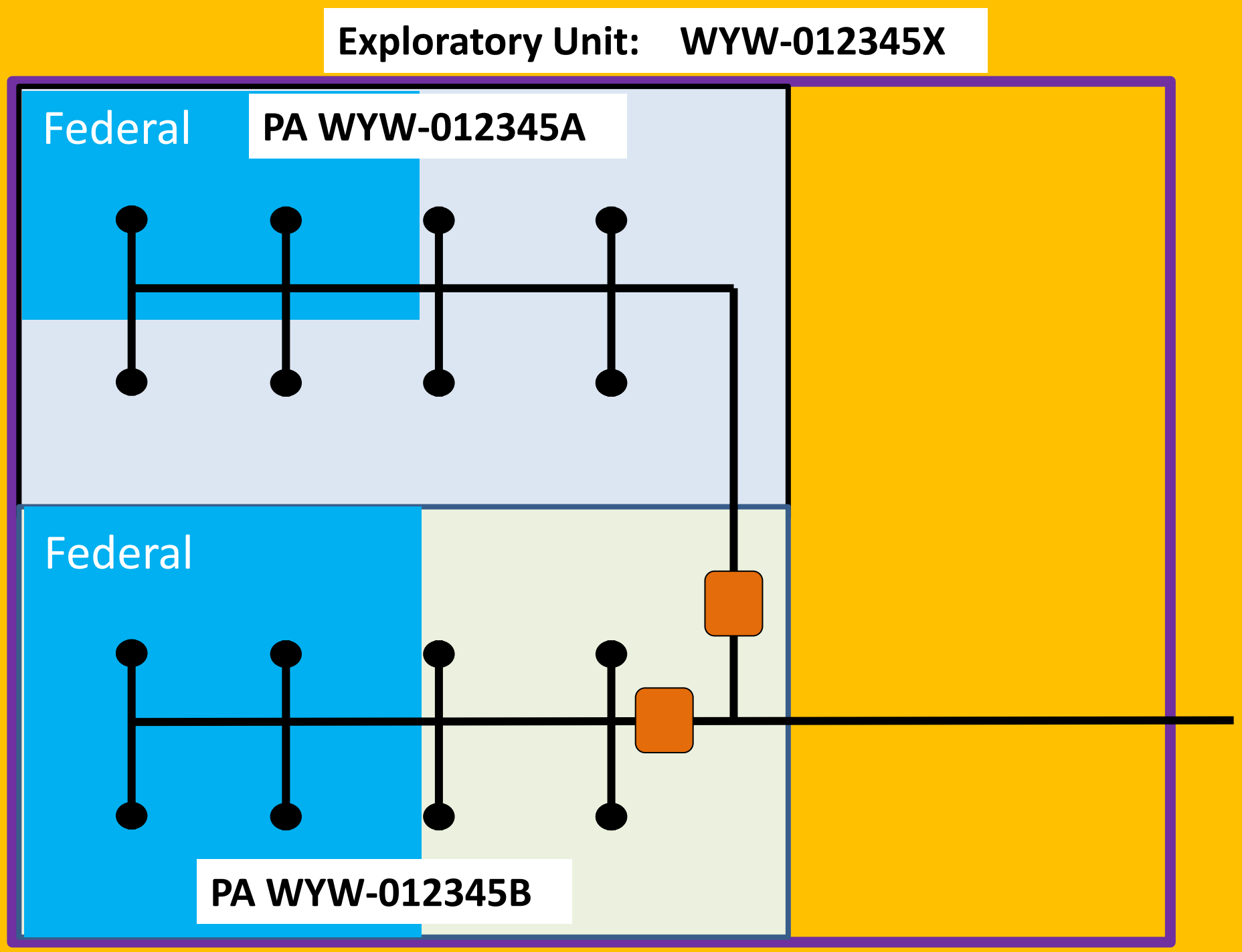

CA: NMN-98765
Federal
Fee
25

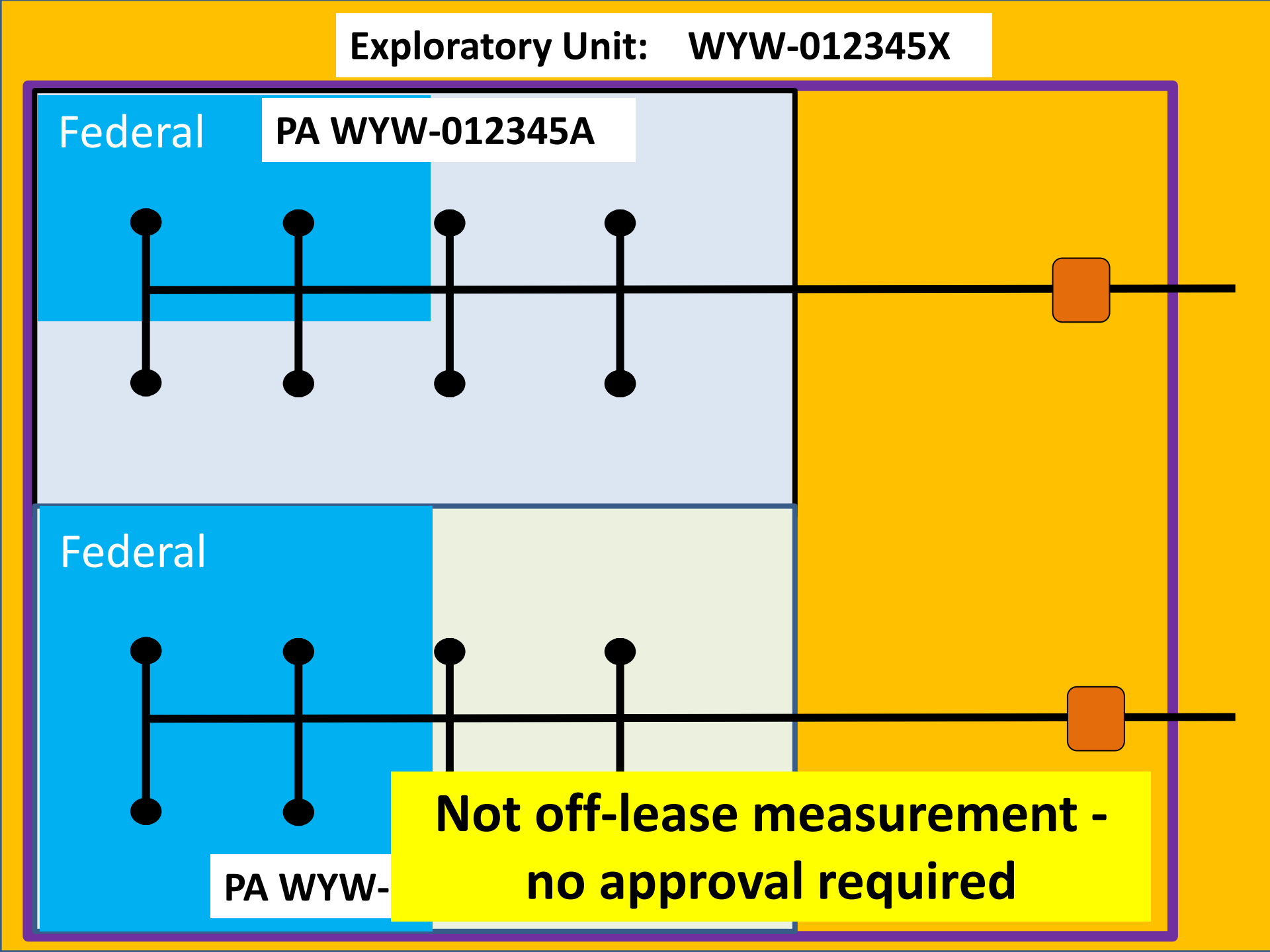

CA: NMN-98765
Federal
Fee
25


CA: NMN-98765
Federal
Fee
25
Not off-lease measurement - no approval required

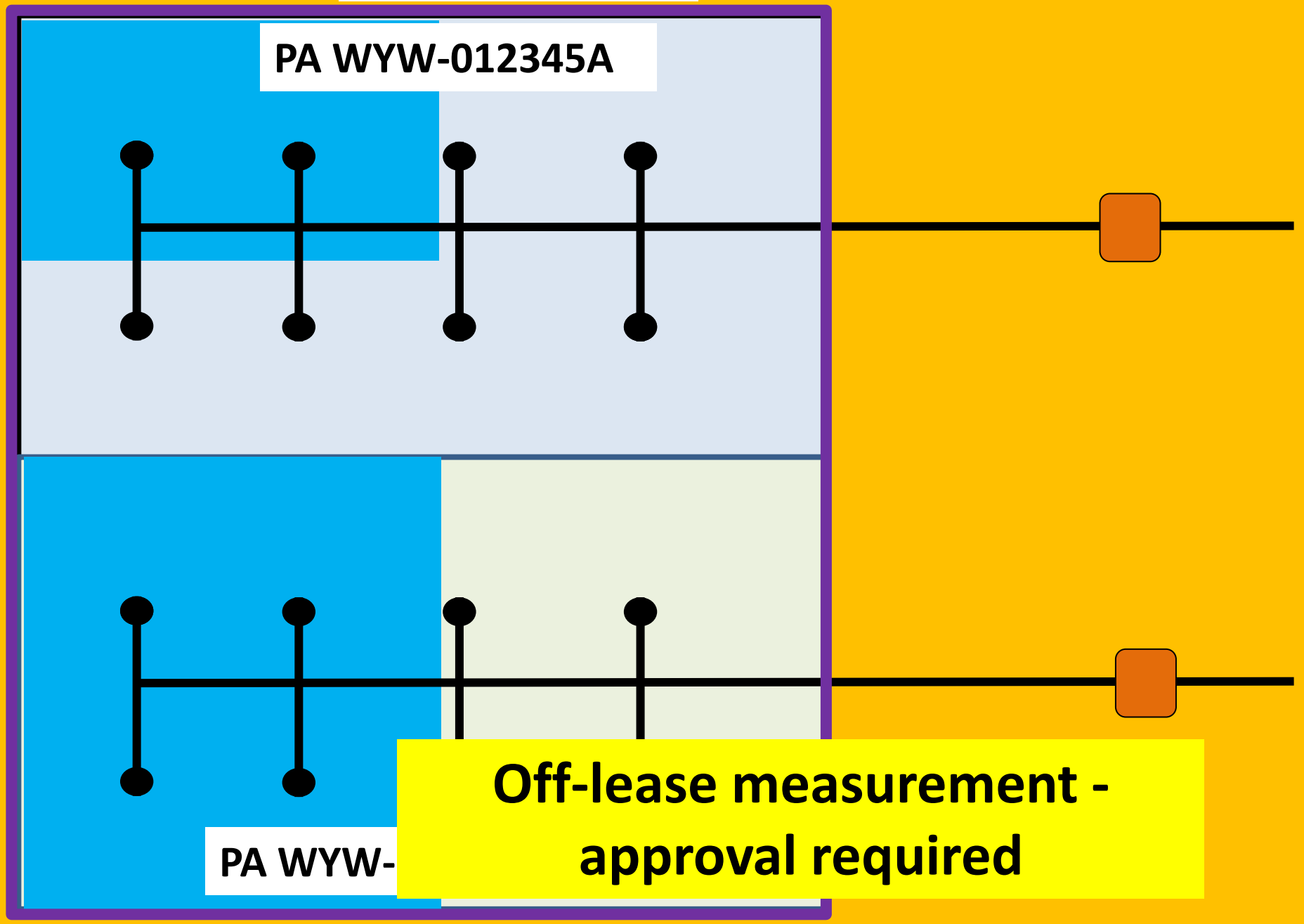
Exploratory Unit: WYW-012345X

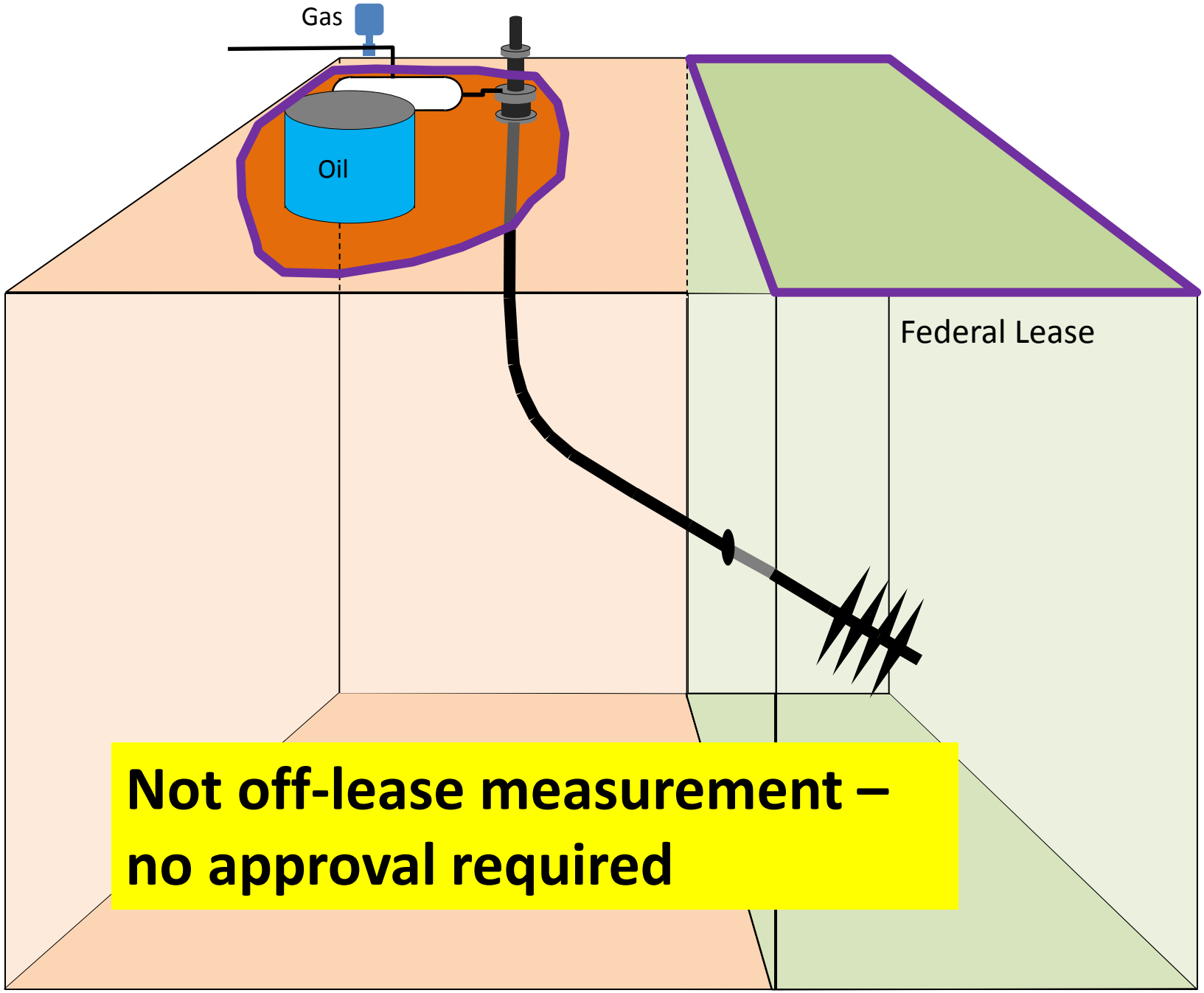


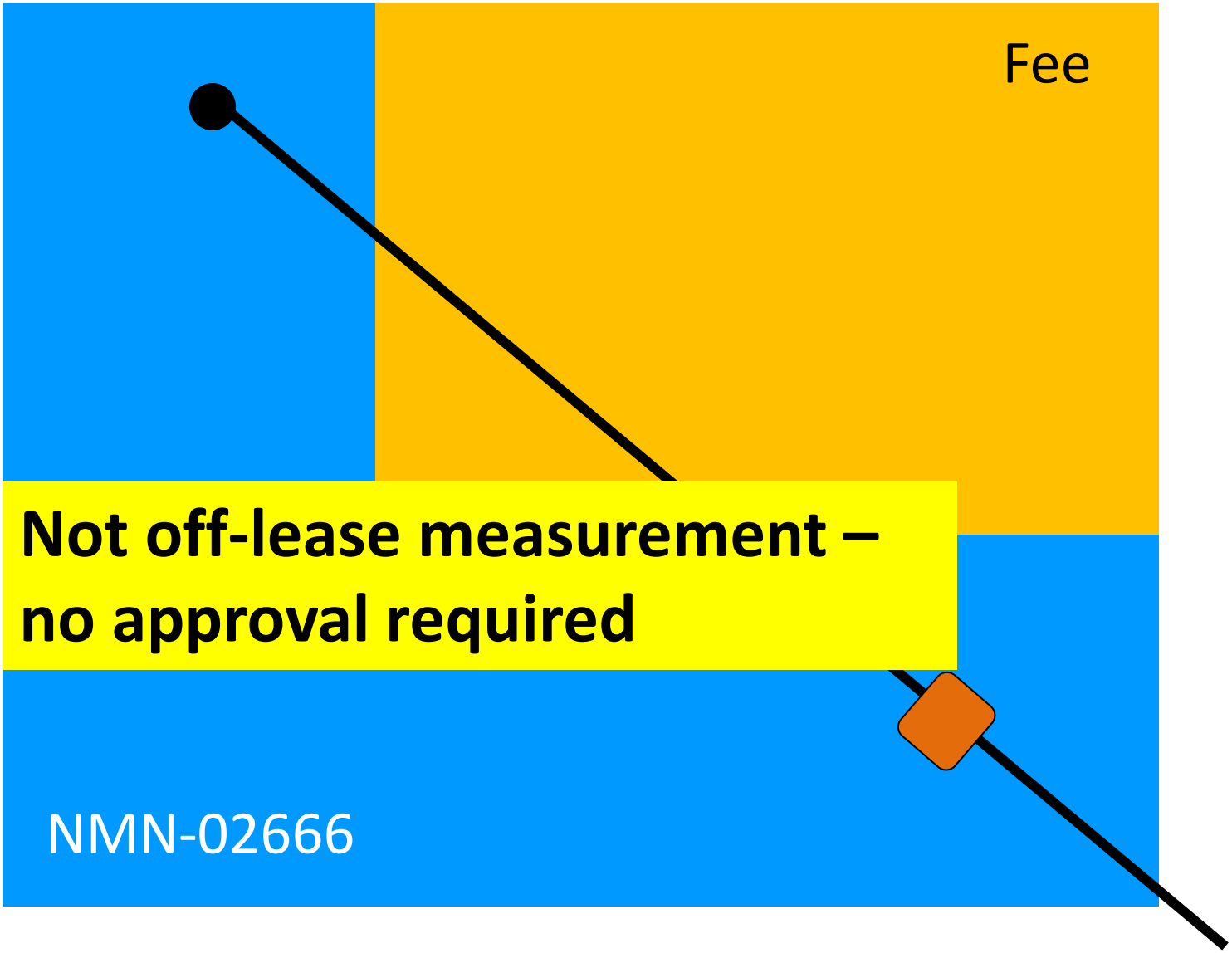

Exploratory Unit: WYW-012345X
Federal
PA WYW-012345A
Federal
PA WYW-012345B


Exploratory Unit: WYW-012345X
Federal
PA WYW-012345A
Federal
PA WYW-
Not off-lease measurement - no approval required

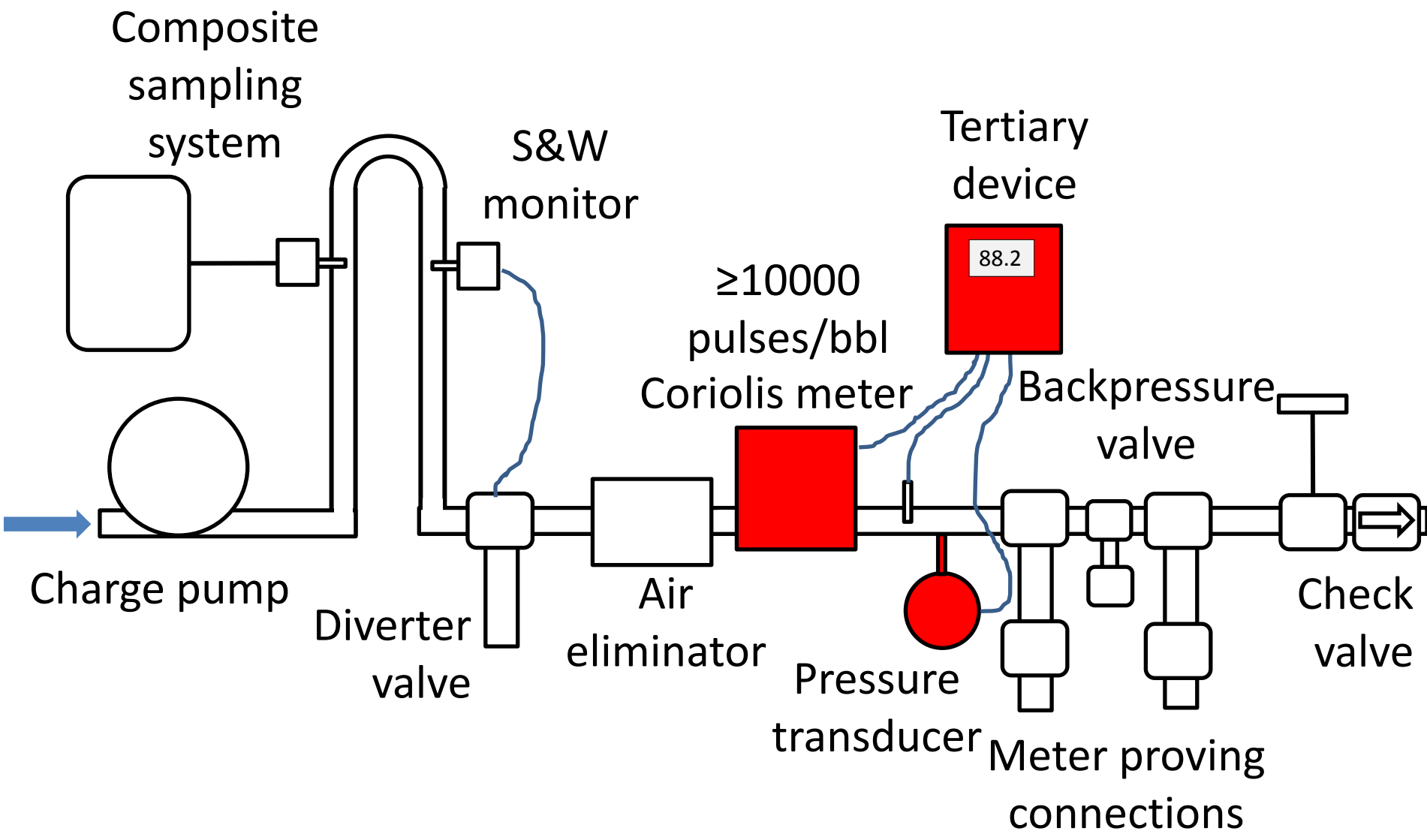
Exploratory Unit:



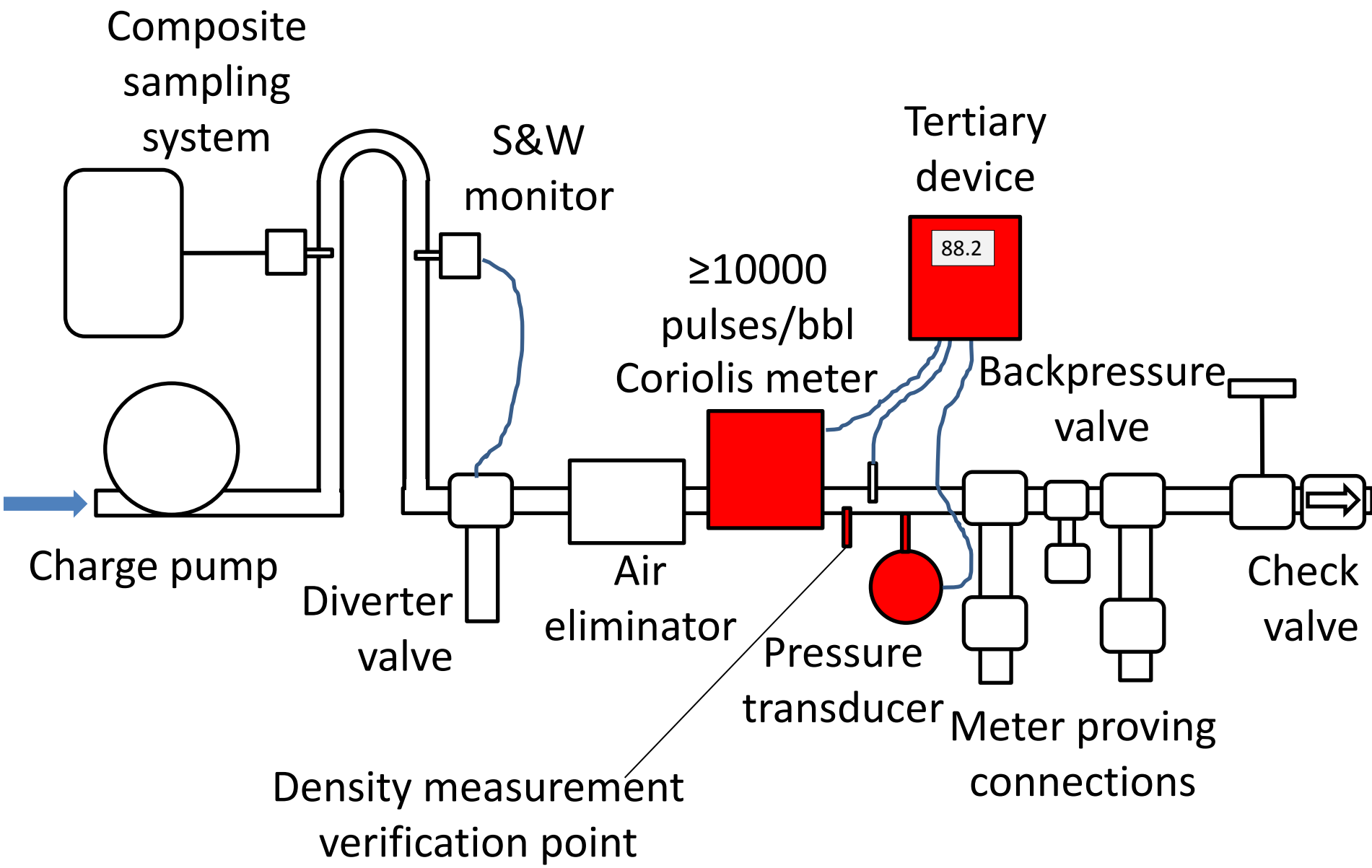

Gas
Oil
Federal Lease
Not off-lease measurement –
no approval required


Fee
Not off-lease measurement –
no approval required
NMN-02666

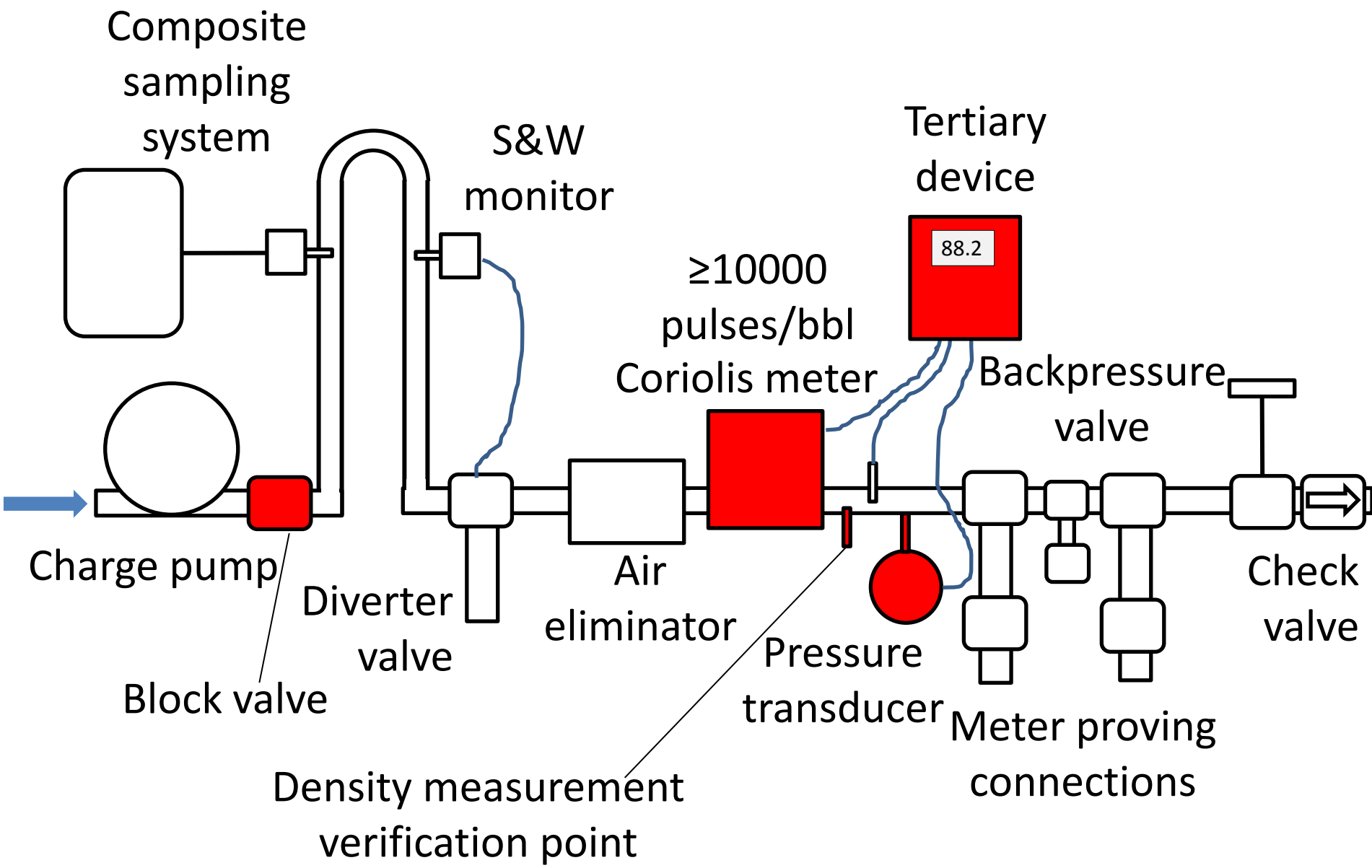
Coriolis Measurement System- Proposed Revision



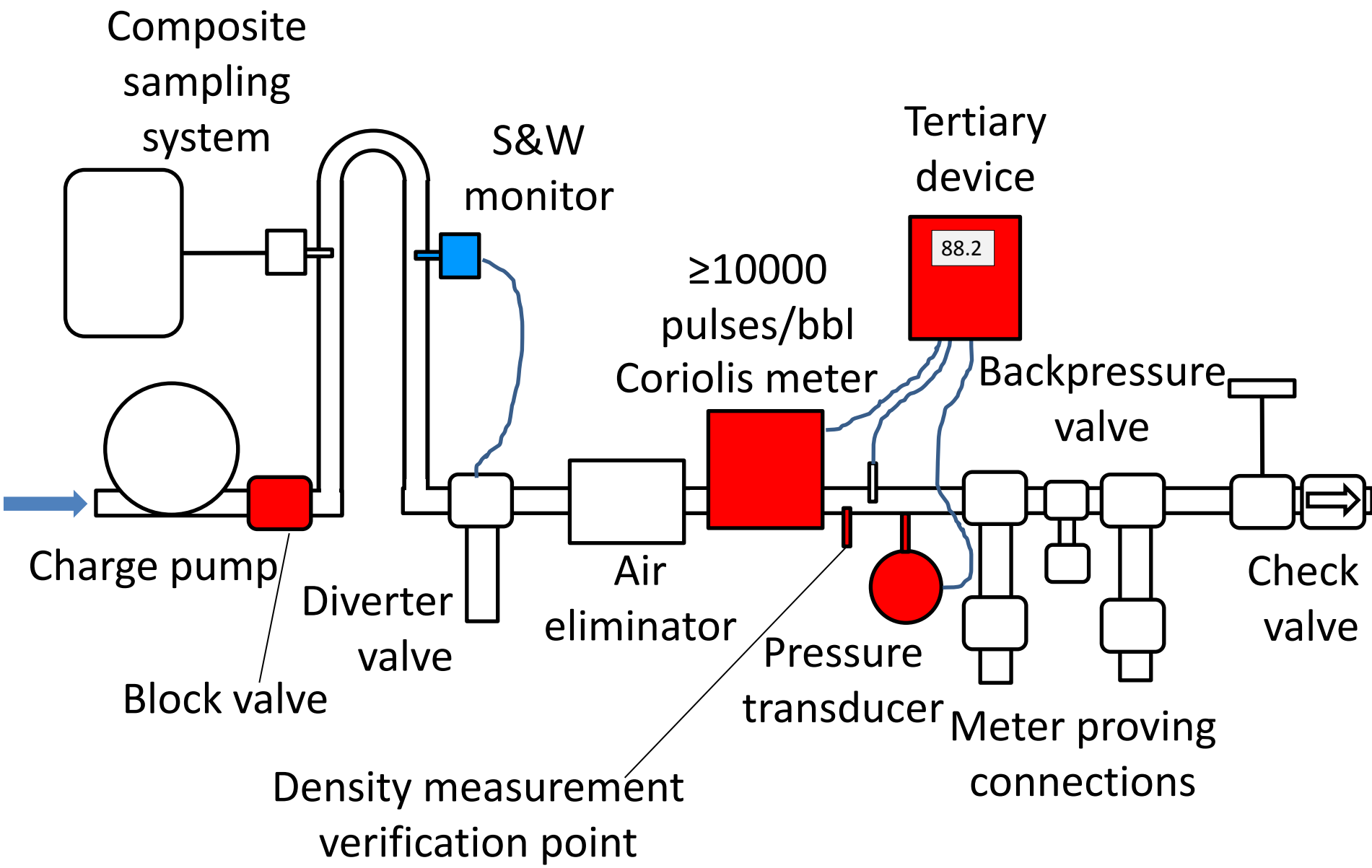
Coriolis Measurement System- Proposed Revision



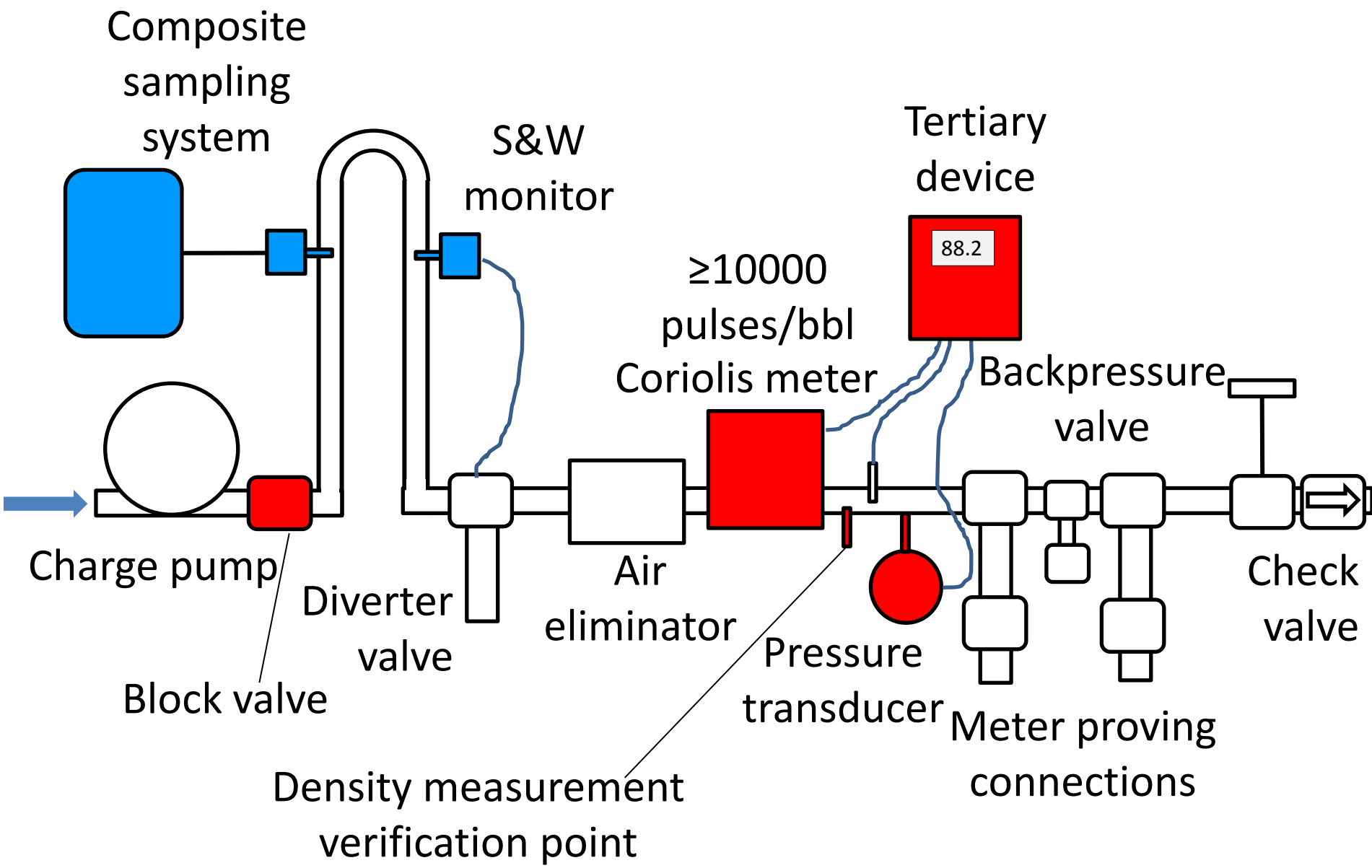
Coriolis Measurement System- Proposed Revision



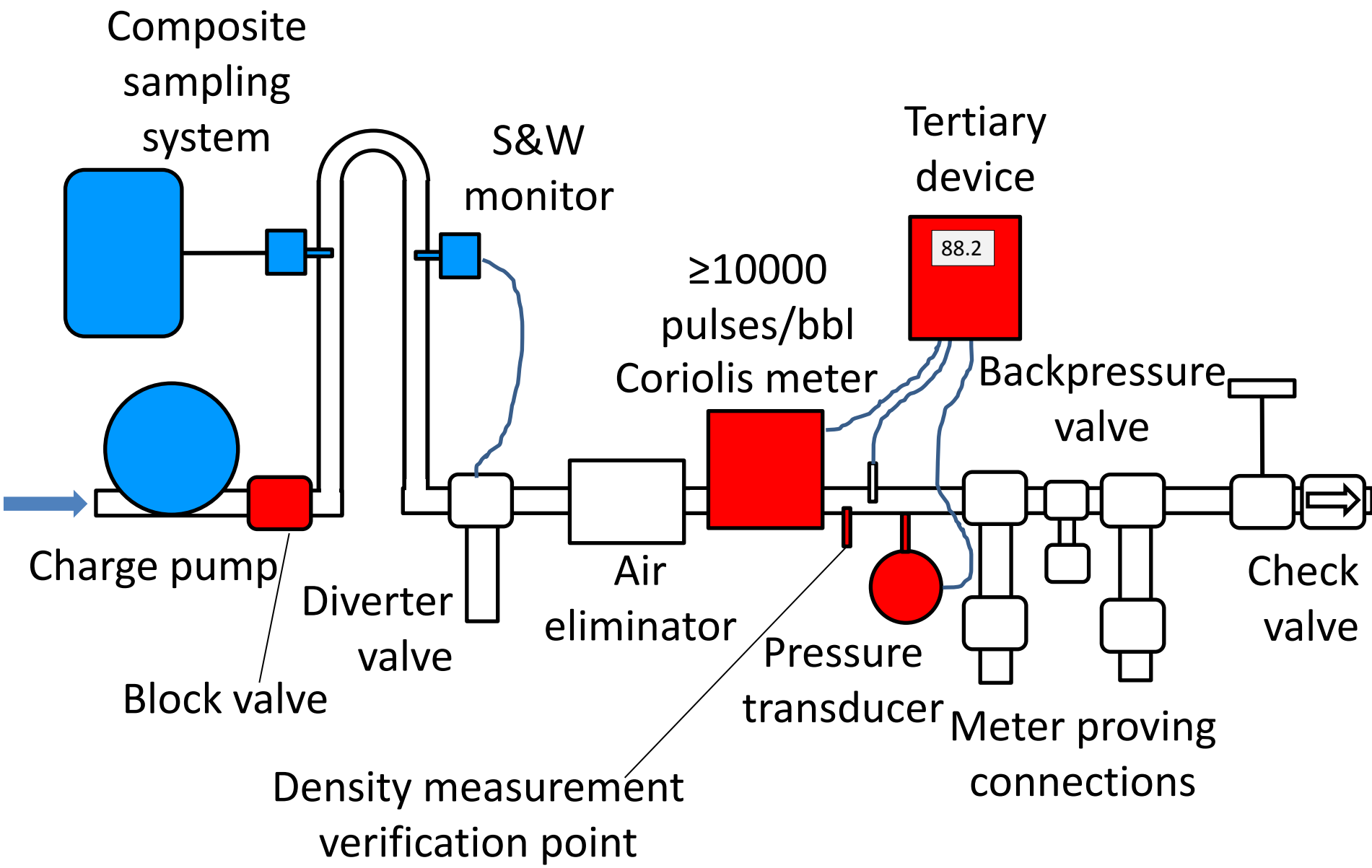
Coriolis Measurement System- Proposed Revision



Coriolis Measurement System- Proposed Revision



Coriolis Measurement System- Proposed Revision



Proposed Coriolis Requirements

- Specification on request
  - Reference accuracy (volume and density)
  - Temperature and pressure effects
  - Zero stability
  - Meter run requirements
  - Pressure and temperature limits
  - Pressure drop
- Non-resettable totalizer for registered volume (bbls at metered conditions)
- Zero check

Proposed Net Volume Determination - Coriolis

Net Volume (NV) calculated for each measurement ticket:

NV = Reg. Volume x MF x CPL x CTL x (1 – S&W)

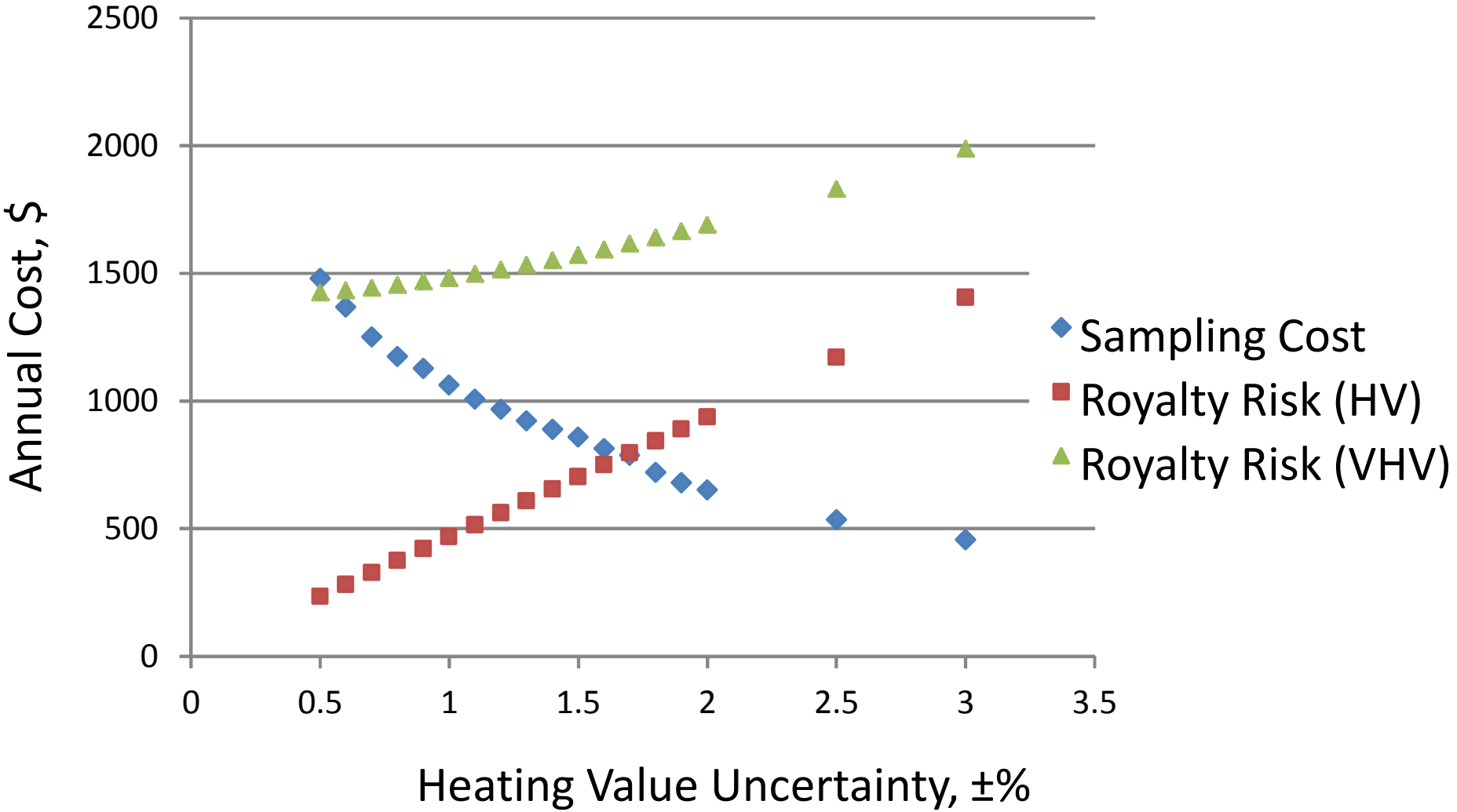
Proposed Revisions to Proving Requirements

- Provers:
  - Displacement (pipe) prover
  - Small volume prover
  - Master meter, PD or Coriolis
- Pulse interpolation if < 10,000/run
- Every 50,000 bbls or quarterly
- Verification of temperature and pressure device
- Density verification (Coriolis) if no sampling system

Proposed Revisions for Measurement Ticket Requirements

- Required for all oil measurement
- Tank sales
- LACT and Coriolis:
  - New ticket 1st of every month and after proving
  - Registered volume
  - Meter factor
  - Average pressure and temperature
  - API gravity (observed, temp., corrected)
  - Reset all accumulators; clean composite sampler

Heating Value Uncertainty Levels


2500
2000
1500
1000
500
0
Annual Cost, $
0
0.5
1
1.5
2
2.5
3
3.5
Heating Value Uncertainty, ±%
Sampling Cost
Royalty Risk (HV)
Royalty Risk (VHV)